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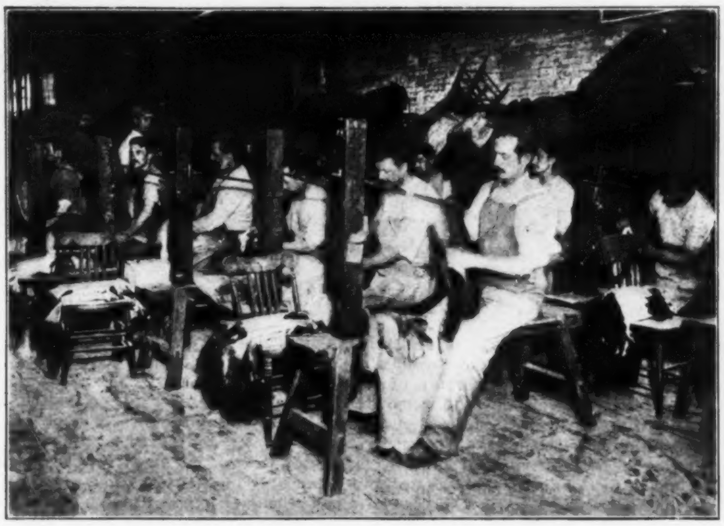
TUBBING, COMBING, AND REVERSING FURS



FLESHING MINK SKINS.

SKIVING BEAVER SKINS.

BEAMING AND PLUCKING BEAVER SKINS.

CLEANING-DRUMS.

BEATING BEAVER SKINS FOR REMOVING SAWDUST, ETC.

THE DRESSING AND DYEING OF AQUATIC FURS.

DRESSING AND DYEING OF AQUATIC FURS.*

By Charles H. Stevenson.

The appearance of aquatic furs as they come from the hunters and trappers is quite different from that which they present when ready to be cut into garments. They are more or less greasy and dirty, and require thorough cleansing. The pelt or membrane must be converted into a form of leather and made soft and pliable, while in some varieties it must be reduced in thickness. The overhair of many skins is quite undesirable and must be removed, this being the case with the fur-seal, beaver, nutria, and cheap grades of otter. The overhair is not removed from all varieties, however, for in some it constitutes the principal attraction, as in the sea-otter, mink, muskrat, and choice grades of otter. The fur-seal alone among the aquatics is usually dyed, but many cheap grades of other varieties are also dyed for the purpose of imitating more valuable ones.

Blueback seal. Harp seal. Wool seal.

SEAL SKINS TANNED WITHOUT REMOVING THE HAIR.

In the dressing of aquatic furs there are no especially valuable trade secrets; but, as in nearly every other industry, some establishments have methods of treatment which they consider superior to those used by others and which they desire to keep from general use. As a rule, however, these secret processes are for the purpose of substitution or imitation, and have little standing among the most successful fur-dressers. In the best establishments the excellent results are due to conscientious application of well-known methods, without stint either in amount of labor or quality of material.

The fur-dressers of the United States are pre-eminent in the preparation of otter, mink, and beaver, while those of Germany rank well in dressing beaver and muskrat furs. The English have excelled for forty years in the dressing and dyeing of fur-seal skins and have prepared the great bulk of those on the market, but the Americans and French now prepare them equally well. The Chinese fur-dressers are the most ancient and among the best in the world. They dress sea-otter skins remarkably well and secure wonderful effects in matching furs of all kinds.

The principal fur-dressing establishments in this country are located in New York city, where the great bulk of the skins are prepared. Smaller establishments exist in Chicago, St. Paul, Newark, and Philadelphia. In Europe the fur-dressing is centered at Leipsic, Weissenfels, and Lindenau, Germany; London, England; Paris and Lyons, France; and Moscow and St. Petersburg, Russia.

When received at the fur-dresser's, peltries are usually hard, greasy, and dirty. If very greasy, as is the case with mink skins, the surplus grease is scraped or beamed off. The skins are soaked in water over night for softening and opening the texture preparatory to the unhairing and leathering processes. Salt water is generally used for soaking, especially during warm weather, as its tendency to loosen the hair is less than that of fresh water. Heavy pelts, as of beaver, otter, etc., are beamed the following day for the purpose of breaking up the texture of the membrane and softening it. The beam on which the skins are successively placed for this purpose is made of some hard wood, as locust, boxwood, etc. It is about 40 inches long and 8 or 10 inches wide, and is placed at an incline of about 45 degrees. The breaker is a dull scraping knife, with a handle at each end like a carpenter's draw knife, and is always operated in a downward direction. After beaming, the pelts are washed in warm soap water until perfectly clean and then they are freed of moisture.

If the overhairs are to be removed, that process is next in order, except in the dressing of muskrat skins, when it is usually postponed until after the dressing. In preparing for plucking, the hair side is dried and warmed by artificial heat, the membrane being kept moist in the meantime. Each skin is placed flesh side down on a flat, hardwood beam, similar to that used in breaking except that it is covered with thick, elastic leather. Chalk is first sprinkled over the hair, and then, using a knife similar to that employed in breaking, a workman rubs or works most of the overhairs out of the membrane. Those not removed in this manner are subsequently plucked out with a dull knife of soft metal. With this knife in his right hand and his thumb protected with a rubber cot about 4 inches in length, the picker grasps the hairs between the edge of the knife and his protected thumb, and with a quick, jerking motion pulls them out, going over the entire pelt in this manner. The fur-seal is quite difficult to unhair, and the process is more complicated.

After plucking, the heavy pelted skins—as beaver and otter—are placed successively on a beam and shaved to a thin, even surface with a skiving knife. The blade of this knife is a straight piece of steel sharpened to a keen edge, which is then turned at right angles to the plane of the knife by means of a peculiar flat steel. This blade is fastened in a tool having two wooden handles differently attached, one running parallel to or in direct continuation of the blade, and the other placed at right angles thereto. Each skin is placed, fur down, on the beam, and by pushing the skiving knife downward and forward from his body, the workman scrapes the pelt perfectly clean and shaves off some of the membrane for the purpose of rendering it less bulky and more pliable.

The skins are now ready for leathering. The pelt side is dampened over night with cold salt water, and the following day butter or other animal fat is rubbed on the membrane. In dressing very fat or oily pelts, as those of mink, the greasing is omitted.

The pelts are then tubbed. This is probably the most noticeable operation in the fur-dressing establishment. Tubs or half hogsheads, slightly inclined backward from the floor, are located in a row along one side of the room. A number of skins are placed in each one, usually with a small quantity of sawdust. A workman with bared feet enters the tub, with a heavy cloth or piece of bagging tied about his waist and to the chimb of the tub to prevent the sawdust from flying out and to retain the heat. By treading and twisting movements he works the skin over and over for two or three hours or more until the pelt is thoroughly softened or leathered. It is a strange and interesting sight to see ten or twelve men working in an equal number of tubs placed in a row, each person monotonously treading and swaying from side to side in solemn manner.

Tubbing is gradually giving way in a greater or less extent to the "tramping machine," whenever anything less than the very best work will suffice. This machine is adapted from the French apparatus for fulling wool stock. It consists of two wooden hammers, which are moved alternately back and forth or up and down in a suitable receptacle, agitating the skins slowly and constantly, turning them over and over each other, and developing by friction the necessary heat, thus rendering the pelts soft and pliable. This process is far more economical than tubbing, costing only 10 or 20 per cent as much. The result, however, is not always so satisfactory, and for the choicest skins tubbing is yet generally used.

At this stage of the dressing process comes the fleshing or skiving, the former being applied to small skins and the latter to large ones. Fleshing consists in removing all particles of flesh and fat by means of a fleshing knife, formed with a broad blade having a sharp edge, fastened in an upright position on a bench. The workman sits astraddle the bench immediately behind the knife, with the edge turned from him, and proceeds to flesh each pelt by grasping it with both hands and drawing it repeatedly across the sharp edge of the knife, cutting off the superfluous flesh. Only small skins, such as mink and muskrat, are fleshed in this manner. Large skins, as those of beaver, otter, etc., are shaved on a beam with a skiving knife in much the same manner as before the leathering process, except that the operation is performed much more carefully.

After fleshing or skiving, the skins are usually put through the tubs or tramping machines a second time, and on removal therefrom are cleaned of grease. In this operation two forms of revolving drums are used, one known as the cleaning drum and the other as the beating drum. The purpose of the former is to extract the grease by means of dry sawdust, and of the latter to remove the sawdust. The drums are usually about 4 feet wide and 6 or 8 feet in diameter, but the size is entirely a matter of convenience and desired capacity.

The cleaning drum is made of wood, and upon its interior circumference are four or five wooden shelves about 6 inches wide and at suitable distances apart. Instead of these shelves, some drums are provided with rows of wooden pins or pegs 6 or 8 inches in length and similarly situated. Sometimes each cleaning drum is inclosed in a wooden closet, which is heated by steam pipes or a charcoal fire. A number of skins, with a quantity of fine, dry, hard-wood sawdust, are placed in each drum. The latter is revolved steadily, making about 20 revolutions per minute, and within three or four hours the dry sawdust absorbs the grease, leaving the fur clean and soft but filled with sawdust.

The beating drum, also sometimes inclosed in a closet, has wooden ends, and its side or circumference is of wire gauze, with meshes about one-fourth inch square. Along the interior circumference are wire-gauze shelves about 10 inches wide, which catch the pelts at the bottom of the revolving drum and carry them nearly to the top, when they slide off and fall against the wire gauze covering the circumference of the drum. In this manner the pelts are cleaned of every particle of sawdust. Many of the larger pelts are beaten with rattans for the same purpose.

SHAVING MINK SKINS.

THE DRESSING AND DYEING OF AQUATIC FURS.

After removing the sawdust and straightening the fur with a steel comb, the dressing process is at an end. This general process would suffice fairly well for all varieties of aquatic furs, but it is modified to suit the characteristics of the different sorts.

Except in case of very cheap skins the expense of dressing furs represents only a small percentage of their value. The following tabular statement shows the average charges that prevail in New York city for dressing skins in quantities for the trade:

* Extracted from the United States Fish Commission Report for 1902.

STATEMENT OF AVERAGE CHARGES PREVAILING IN NEW YORK CITY FOR DRESSING AQUATIC FURS.

Species.	Dressing.	Dressing and plucking.
Beaver	$0.50	$0.60
Fur-seal*	.....	3.00
Mink: Cased	.15	.....
Open	.14	.....
Mink tails	.03	.....
Muskrat	.06	.08
Nutria	.....	.25
Otter	.50	.65
Sea-otter	2.00	.....

* Dressing, plucking, and dyeing, $5.

With the exception of the fur-seal, the choicest furs of any particular species are rarely dyed. Indeed, their degree of excellence is determined by the nearness of their approach in the natural color to the most desirable shade for that species. So important is this that a skin of proper tint may be worth three or four times as much as one whose texture is equally fine but lacking just the right shade. For instance, the present average value of prime dark sea-otter skins is about $600 each, whereas the average price of prime brown skins is only $200. In case of mink, otter, and other choice species, the difference is as great in proportion.

In order to obtain those shades which taste and fashion have determined to be the most desirable, much of the aquatic fur is dyed. Either the ends of the fur and hair are merely tinted, or the color of the entire skin may be changed. The object of tinting or blending is to make all parts of the fur used in a garment of the same color, to make an inferior grade of fur like that of a superior, or to cause the fur of one animal to resemble that of another. Certain furs so closely resemble choicer ones in every particular except color, that when dyed to a similar hue they are almost indistinguishable to the casual observer.

While dyeing may be a cheap and ready process in the treatment of low-priced furs, it is an art when applied to choice skins. Its perfection consists in the exact imitation of the proper color and tint, with the preservation of the glossiness of the fur and its natural firmness and pliability, and, finally, in the durability of the dye. In case of the fur-seal, fashion has decided that the color shall be changed to a lustrous, blackish brown, an original color resembling nothing whatever in the animal kingdom.

Some skins of beaver, otter, etc., are "silvered" by passing lightly over them a solution of sulphuric acid, and also some are made a golden yellow by means of peroxide of hydrogen. Dyed furs are generally not so durable as those left in the natural state, the artificial color fading and the garment sooner presenting an old and worn appearance.

The dyeing of furs is of great antiquity, but its principal development, in America and Europe at least, has been within the last forty years. Experiments on the part of conscientious and able chemists have resulted in greatly improving the permanency of the dyes and lessening their injurious effects. The methods are constantly undergoing changes and many improvements are introduced from time to time. The composition of the new dyes and the methods of applying them are carefully guarded from general knowledge. One frequently runs across published directions for compounding the dyes and methods of applying them, but usually these descriptions are totally valueless, the methods described being either superseded by better ones or being lacking in essential ingredients.

The number of successful dyers in the world is very small. Their prosperity is dependent as much upon the elimination of competition as on the excellence of their work, and consequently they are not proclaiming from the housetops the composition of their dyes, frequently the results of long and costly experiments.

NATURAL PRODUCTS AND SCIENTIFIC INDUSTRY.

Of all the scientific problems of the present day, none possesses greater fascination than that of the imitation of the more precious natural substances. These substances, whatever be their nature, are only produced in limited quantities; and if they are highly valued on account of their possessing certain special qualities, the inevitable result is that the demand soon exceeds the supply, and the price of these materials rises till finally their employment for purposes which would lead to an excessive consumption, if the price were low, is dispensed with.

Consider, for instance, the multitude of articles that would be made of ivory if it were not so expensive! Only male elephants, however, have tusks, and the latter are not fully developed till in the later years of the animal's life. In spite of the reckless manner in which elephant hunting is carried on, in spite of the enormous price now paid for good ivory, the demand for this precious material is always in excess of the supply. The same is the case with tortoise-shell. The beautiful properties of this material have made it so popular, that fishing for turtles is carried on with the utmost recklessness, and to such an enormous extent that sooner or later there will be no more tortoise-shell in existence. The same thing is happening in the vegetable kingdom, and here, too, the most valuable substances are used up more quickly than they can be produced. Good India-rubber is becoming scarcer every day; the number of old oak trees, yielding well-seasoned wood, is diminishing everywhere; the manufacture of gun-stocks is making serious inroads on the supply of walnut trees in south Germany and Switzerland, while the beautiful old mahogany, of which our grandfathers made their best furniture, is simply not to be had any longer, and light mahogany, stained red, has to take its place.

These conditions—and instances might be multiplied indefinitely—have given a strong impulse to the desire, by artificial means and by making skillful use of the properties of easily accessible substances, to produce materials which may replace these rapidly diminishing natural products, at any rate for many purposes. The results already achieved in this direction are astounding, especially when a closer examination of the problem reveals the fundamental difficulties which lie in the way of these efforts. It may not be uninteresting to consider the matter a little further.

When we examine the natural productions of the animal and vegetable kingdoms, it is necessary to make a clear distinction between the chemical products which we extract from nature and the organic materials which she holds at our disposal. With regard to the first, there is no reason why we should not succeed in producing every one of these substances synthetically in our laboratories in at least as profitable a way as nature produces them and in even better quality, for nature very seldom yields them in a pure condition. In most cases they contain various admixtures which impede their useful employment. Artificially produced alizarine and purpurine are much purer than the corresponding constituents of madder-root, and they yield much cleaner and finer dyes. The same thing has been observed in the case of artificially prepared indigo; in fact, its great purity and the resulting freshness of the dyes produced by its aid were for a time obstacles to its general use. Artificial vanilline is known to possess a much more perfect aroma than the vanilla beans still used by some people—the latter containing, in addition to the matter which gives them their characteristic flavor, certain rancid and bitter substances.

There are, of course, many substances which, in spite of our efforts, we have been hitherto unable to imitate. The chemical composition of India-rubber, for instance, is still a mystery, and the synthesis of sugar can be regarded as a success only from a scientific, not from a practical point of view. In fact, the synthesis of sugar is not likely ever to be of any practical use, as this substance is found in unlimited quantities in nature, and is consequently so cheap that it is most improbable that the artificial product will ever be able to compete with it. Very applicable to the question of the manufacture of sugar on a large scale is the reply made to a celebrated scientist who had asserted that when once we have succeeded in extracting starch from cellulose (which is by no means impossible in view of the close affinity between the two substances), the problem of the synthetic production of food will be solved! He had quite overlooked the fact that a fairly pure cellulose, such as would be necessary for the process in question, would be dearer than good starch, and that therefore there would be no object whatever in making starch from cellulose. The reverse operation would have a far greater prospect of practical utility.

But although economic considerations, as we have seen, play an important part in the question as to the practicability of every proposed synthesis, there can be no doubt that every chemical product which nature supplies can be artificially reproduced, and will be so reproduced sooner or later. It is quite otherwise with organic substances. These we shall never be able to reproduce and shall be obliged to confine ourselves to imitations and substitutes. The reason is explained by the word which we have had to prefix to the term "substances" to express our meaning. By no artificial means shall we ever be able to produce ivory, tortoise-shell, horn, bone, whalebone, leather, the numerous kinds of wood, the endless varieties of textile vegetable fibers, catgut, horsehair, eiderdown, ostrich-feathers, vegetable ivory, and mother-of-pearl. This can be said with absolute certainty, because these substances owe their properties not only to the matter of which they are composed, but, and in many cases principally, to the structure and configuration which nature has given to this matter. In the substances which we have mentioned it is the fine texture, visible only under the microscope, which is the really important thing. Ivory and bone are chemically the same thing, namely, cartilage interspersed with fine granules of calcium phosphate, but how different are these two substances in their properties and their value! Who would imagine from their external appearance that wool, horn, and tortoise shell, or cotton, vegetable ivory, and cork are, in essentials, chemically almost identical? It is the special and peculiar arrangement of the cells, the smallest elements of which these bodies are built up, that gives them their characteristic properties, and determines their utility and value.

It is perfectly possible, though it has not yet been accomplished, that cellulose, of which cotton, flax, and many other useful materials are composed, will be produced synthetically, but when we have succeeded in doing this, the result will not bear the remotest resemblance to cotton and flax and will be useless as a substitute for them. All we shall get will be shapeless white locks drying up to a horny mass. The peculiar properties of the fibers of cotton and flax are due to the conformation which nature has given to the cellulose in these substances.

This being so, all we can hope for in our efforts to supplement the scanty supply of organic material in nature by the produce of human industry is to make more or less successful imitations and substitutes. But, as we have already said, the progress that has been made in this direction is astonishing.

Take tortoise-shell, for instance. We are not able to make kerdline, of which this material is composed; still less can we imitate the texture of tortoise-shell. We have, however, got a substance which, though homogeneous and inorganic, possesses the same horny quality and the same elasticity as tortoise-shell; this is celluloid, a substance obtained by mixing gun-cotton and camphor and which, when freshly prepared and warm, is a pasty and plastic mass. Any required color can be given to it, and we can obtain a veined and transparent mass by kneading together variously colored portions of celluloid. In this way we are able to make a substitute for tortoise-shell, so closely resembling the natural product that either can quite easily be mistaken for the other. Of course, the differences in the qualities of the two substances, arising from fundamental dissimilarity of composition and structure, can be detected, but the fact remains that we have in this case succeeded in obtaining a substitute, quite good enough for many purposes and welcome on account of its moderate cost.

The same substance has been used, though not so successfully, as a substitute for ivory. To obtain the white color, celluloid in a pasty condition is kneaded together with large quantities of zinc white. It is of course hopeless to attempt to reproduce the microscopic structure of ivory, but the characteristic texture of the valuable product, recognizable by the eye, has been imitated in the most successful manner by laying sheets of celluloid impregnated with varying quantities of white pigment one on the top of the other and forming the whole into blocks by powerful pressure. The same method has been applied to other materials which perhaps resemble ivory still more closely as regards specific weight and the feeling to the touch, but without success.

The number of substances adapted to the more or less successful imitation of valuable natural products is legion, and their utilization for such purposes has often been the result of considerable inventive capacity and thoughtful scientific work. What a variety of articles can be made of viscose, for example, a cellulose deprived in the most ingenious way of its organic form and precipitated as a homogeneous mass! Consider the numerous uses to which gelatine, albumine and casein can be put! The Harburger Gummikammfabrik has recently used the last-named substance for making imitations of horn, bones, ivory, vulcanite, and valuable stones, which are said to be highly successful.

Some of these materials, originally regarded merely as imitations of natural products, have won for themselves a recognized and independent position in the scientific world by reason of their excellent and peculiar properties. Ebonite has ceased to be valued merely as a substitute for a natural product and has a sphere of usefulness of its own. What would applied electricity do, if deprived of its most valuable insulating material, vulcanite-fiber?

It is clear, therefore, that substantial progress has been made in this region also, where a consideration of fundamental principles would appear to forbid us to indulge in any great hopes of success. Fortunately inventors of the genuine stamp do not concern themselves to any great extent with fundamental principles. They quietly go on inventing, leaving to other minds, more logical, perhaps, but not gifted with much inventive capacity, the task of afterward developing the theory of their work. That is as it should be.

The boldest inventor, however earnestly he may endeavor to realize apparently impossible ideals, will not attempt to impress upon artificial products the conformation which nature gives to organic bodies. But between this insoluble problem and the mere substitution of homogeneous masses for organic materials lies an extensive region, which science from the earliest times has frequently encroached upon and with unquestionable success. The results obtained in this region and the principles on which they depend will form the subject of my next article.—From the German of Dr. Otto N. Witt, in Prometheus.

PETROLEUM AS A SUBSTITUTE FOR TURPENTINE IN PAINTS.

For some time past experiments have been carried out with a view to discovering a petroleum product which would prove equivalent to turpentine in the manufacture of paints. The great difficulty, however, is that in paints, especially of the cheaper kinds, substitutes and adulterants are so freely used that every particle of coherence that turpentine can supply is required. Benzoline is used for this purpose, but it evaporates with no residue or none of the required drying faculty. Substitutes also for linseed oil have been tried, but with indifferent success. What is required is a cheap process, by which an abundant oil can be made to dry, in order that the finished oil can undersell linseed oil in the markets. Experiments in improving the siccative qualities of cheaper vegetable oils with this in view have failed thus far to obtain any advantage in price.

In the manufacture of printing ink a large demand for fine linseed oil is required, but in manufacturing the common black ink for printing newspapers, there is need for an oil considerably less costly. Resin oil and fir oil are extensively used in the latter, as well as

petroleum of cheap lubricating qualities. For printing rapidly upon thin paper, a tough ink is out of the question; therefore, to reduce the mass to a slippery consistency, and to give it so much fluidity that it shall at once enter the pores of the paper, petroleum is added. Drying is a complication of three processes—absorption, evaporation, and oxidation—which can be compiled by a skillful mixture of ingredients. The problem is aggravated by temperature, moisture, speed of working and class of paper. Nor does the consumption of petroleum by printers end here. The pigment of the high-class inks used to reproduce illustrations is usually American gas-black. The impalpable powder of gas or oil burned in the American fields is captured on fine plates or revolving drums. Fineness and brilliance of hue commend it for use alone, or with commoner and softer textured lamp-black.

THE EVOLUTION OF ESCAPEMENTS.

The invention of new escapements continues. Every year the technical publications record various attempts in this branch. Many a watchmaker, after having for years brooded over the idea of a new escapement, which he thinks will replace all existing

FIGS. 1 AND 2.

systems, finds that when he makes known his invention, the idea has already been elaborated, and that it is necessary, in order to secure anything new, to explore all the treatises of horology, ancient and modern.

A work presenting designs of all the combinations and varieties of escapements that have appeared would

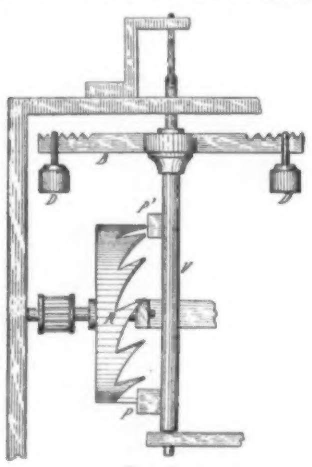


FIG. 3.

be of great service, not only to future inventors, but to horologists in general. The Almanach des Horlogers-Bijoutiers will in this number make a beginning, and form a base for a special publication on escapements.

A new escapement can succeed only when it gives better results than those already adopted in practice, and there will be no chance of success if the manufac-

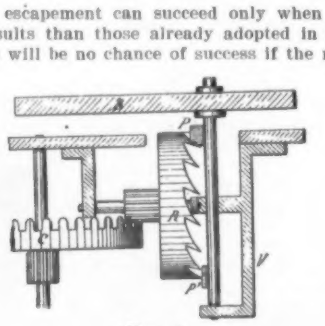


FIG. 4

ture is more difficult. The four escapements in use to-day in ordinary timepieces will be difficult to displace. These are the free, or detached lever, escapements, and the cylinder dead-beat escapement for watches; the recoil anchor escapement and Graham's dead-beat escapement for clocks.

It is easy to foresee that in watches the cylinder escapement will give place more and more to that of the lever. The latter will probably never be supplanted, for it will be next to impossible to invent a better. In clocks the recoil anchor will certainly be preserved for a long time for ordinary pieces having a

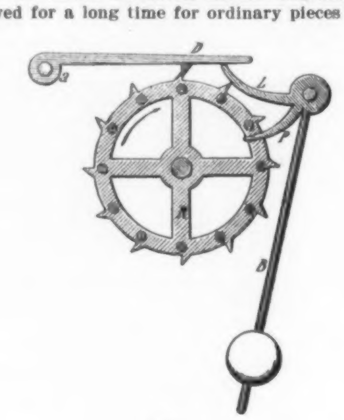


FIG. 5

short pendulum, and the Graham anchor, modified perhaps in construction, but not in its principle, will still remain the preferred escapement for the good timepiece and for the current regulator of precision.

The invention of the original recoil escapement dates from the origin of mechanical horology. Those of the

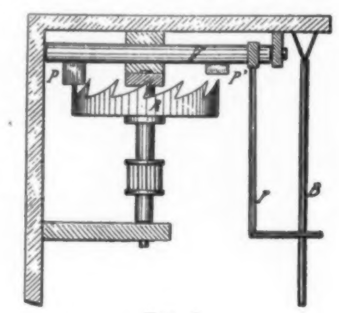


FIG. 6.

cylinder and of the Graham anchor are about two centuries old. The detached lever escapement of watches was invented a century ago. During this interval numerous systems have seen the light, but none united sufficiently the qualities necessary for general use as well as the four escapements mentioned.

In this consideration we lay aside the various escapements that may be made use of in horology of high precision. These give marvelous results in the rate, but they are too delicate and costly for general adop-

FIG. 7.

tion in time-pieces. We do not wish to discourage investigators too much. Every new invention may contribute to the general advance of horology. If, in a particular case, it is not successful, it may be the parent of others; and all new ideas are valuable for the general advance of horological training.

In every invention the object is the patent first, then the profit. But with regard to the invention of escape-

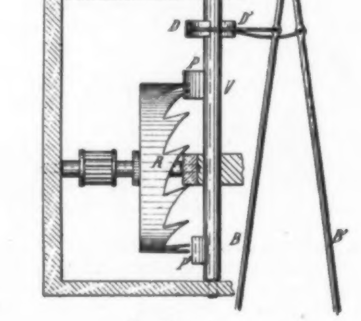


FIG. 8.

ments, there is now but little hope of attaining this end. If a new escapement is produced, the inventor will probably risk his labor for the reputation acquired. Our advice is, therefore, in all cases, not to make a search after profit in new patented escapements.

In the history of this subject we find, not only numerous perfected inventions, but many that never passed the state of experiment. We will trace some of these, and they will form a good foundation for further research by our collaborators.

FIG 9.

The problem to be solved by means of the escapement consists in moderating, within regular and precise limits so far as possible, the distribution of the motive force; that is to say, the progress of the train, and consequently that of the hands.

It would seem at first that a moderator in continuous movement, such as that of the steam engine, for example, ought to accomplish the object desired. At-

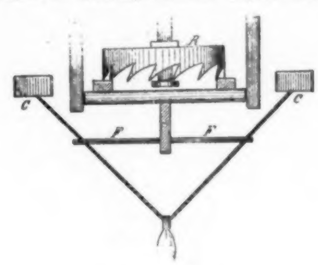


FIG. 10.

tempts have been made in this direction, but the results have not been satisfactory. The only recognized method for rendering the distribution of the motive force as regular as possible, consists in intermittent interruptions in the progress of the train, in order to obtain a movement periodically uniform.

Whatever may be the system or kind of mechanism,

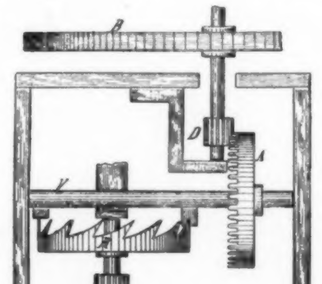


FIG. 11.

its functions consist in suspending in an intermittent manner the rotation of the last wheel of the train, and in transmitting to the regulator, pendulum, or balance the force communicated to this wheel.

Of all the parts of a horary machine, the escapement is the most important. It is that which assures

FIG. 12.

the regularity of the rate, and which gives to the time-piece its real value. The best escapement will, therefore, be the one which performs its function with the least influence on the duration of the oscillations of the regulating organ.

The arrest of the train by the escapement is accom-

plished in different ways, which may be referred to three distinct categories. In the first two the stoppage is effected directly on the arbor of the regulator, or against a piece which forms one body with this arbor.

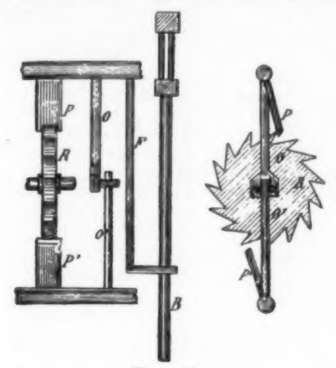


FIG. 13.

The tooth of the 'scape wheel remains pressed against the object, arresting it until the moment of its disengagement. In the first escapements contrived, and even in some still employed in certain clocks, a recoil of the wheel will be noticed during the locking. To mechanism of this kind, the name *recoil escapement*

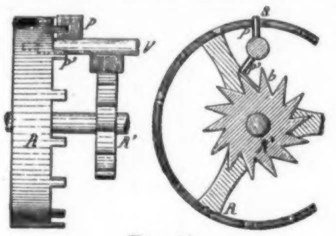


FIG. 14.

has been given. It has been found that the recoil is prejudicial to the regularity of the rate, and after the invention of the pendulum and the balance spring, it was displaced by the dead-beat escapement. In this, the wheel arrested by the arbor of the regulator remains motionless up to the moment of its unlocking.

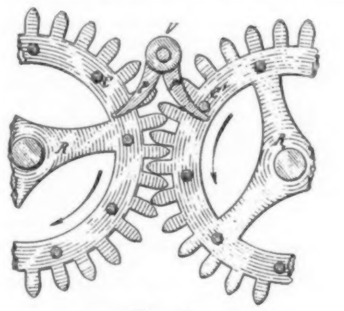


FIG. 15.

In the third category, the wheel is stopped by an intermediary piece independent of the regulating organ. The latter accomplishes its oscillations in full liberty, and is in communication with the train only for the instant of the impulse designed for keeping the regulator in movement. This category includes the *free* or *detached escapements.*

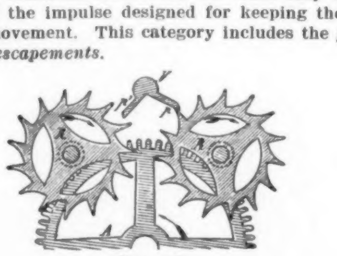


FIG. 16.

The principal types of recoil escapements are the verge or vertical escapement for watches and clocks, and the recoil anchor escapement for clocks. The cylinder escapement and the duplex escapement for watches, and the Graham anchor escapement for clocks, are the most common types of dead-beat escapements.

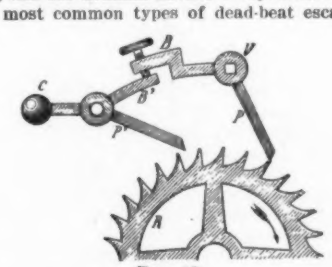


FIG. 17.

Among the detached escapements, we have the lever escapement and the detent or chronometer escapement for watches; the free escapement for clocks is not of determined type, or of current application.

The verge escapement, called also the vertical or crown escapement, is the most simple, and presents the least difficulty in execution. Its invention, of the date and author of which we are ignorant, appears to go back to the birth of mechanical horology. It was employed almost exclusively until the year 1750. In 1850, the

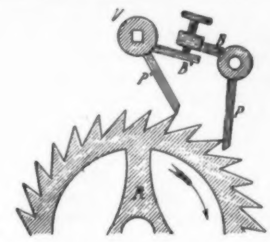


FIG. 18.

greater part of ordinary watches were still furnished with the verge escapement, and in our days it is still used in the form of the recoil anchor in ordinary clocks. In 1802, that is, eighty years after the invention of the cylinder escapement, Ferdinand Berthoud, in his "Histoire de la Mesure du Temps" (History of the Measurement of Time), said with reference to the vertical escapement: "Since the date of this invention, a multitude of escapements have been constructed, but this, which is employed in ordinary watches, still the best."*

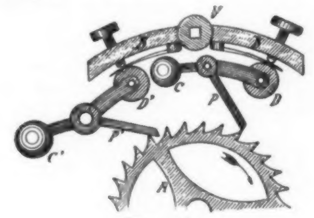


FIG. 19.

Figs. 1 and 2 represent a verge escapement, with crown wheel and verge *V* furnished with its two pallets. The verge may be placed horizontally, as in Fig. 2, or vertically, as in Fig. 1. The tooth *d* of the wheel *R*, repelling the pallet *P*, is on the point of escaping, and the opposite tooth *e* is about to be locked against the pallet *P'*; this, under the impulse communicated by the tooth *d*, will at first cause the wheel to recoil;

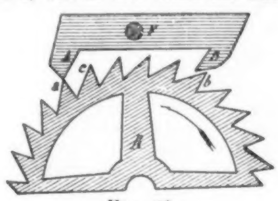


FIG. 20.

then, in its turn, it will be subjected to an impulse. The tooth *e* will pass on, and it will be the turn of the tooth *c* to be arrested by the pallet *P*. The teeth of the wheel are generally 11, 13, or 15 in number; always an odd number.

This escapement has the advantage or not requiring oil, and of being easy to keep going, even with mediocre execution.

Fig. 3 shows us the most ancient arrangement known of the verge escapement in a clock. *R* is the 'scape

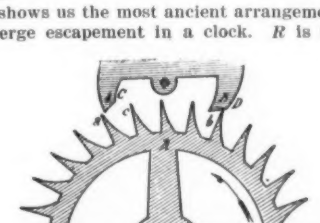


FIG. 21.

wheel (vertical wheel), working the pallets *P*, *P'*, which form a solid piece with the verge *V*. The verge, suspended as freely as possible by a flexible cord *C*, carries at its upper end two arms *B*, *B*, called *foliots* or *régules*, forming the balance. Two small weights

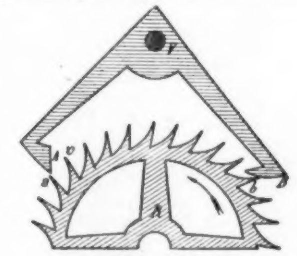


FIG. 22.

D, *D*, capable of moving along the *régules*, allow of modifying the duration of the oscillations.

* This sentence, taken alone and construed strictly, would mean that Berthoud considered the verge escapement superior to all others, but in different parts of his work he confines his commendation to common watches, designed to be constructed at a moderate cost.—Trans.

In Fig. 4 we have the arrangement adopted in watches. *B* is the regulating circular balance, not yet furnished with a spring. *C* is the last wheel of the train, called the crown wheel, on account of its teeth rising perpendicularly to the plane of the wheel. The verge furnished with its pallets is placed vertically, as in the preceding arrangement.

It was soon found that this system did not afford very good results with reference to the regularity of the rate. Influenced by the slightest variation in the motive force and by the least jolting, the vertical escapement, not provided with a regulator having in itself a regulating force, could not secure a regular rate. The mechanical clocks provided with this escapement still had a great advantage over the ancient clepsydras, and notwithstanding its imperfections, it rendered important service, especially after striking mechanism was added.

No improvement was introduced in this escapement,

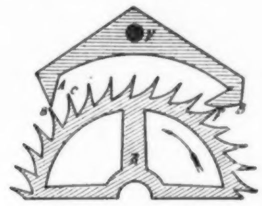


FIG. 23

or in the regulator, for more than three hundred years, and in 1600, at the time of the discovery by Galileo of the laws of the oscillatory movement of the pendulum, it was not suspected that this discovery would have important consequences for the measurement of time. Galileo, notwithstanding his investigating genius, did not know how to separate the simple pendulum from the compound pendulums that he studied, and he attributed to the vibrations a general isochronism which they did not possess. He did not apply his

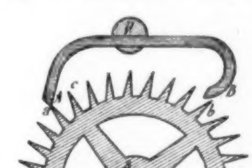


FIG. 24.

discovery to the measurement of time, and it was only half a century later, in 1657, that the celebrated Huyghens published his memoir, in which he made known the improvement for clocks by adapting to them a pendulum designed for regulating their rate.

Attempts have been made to claim for Galileo the glory of having first applied the pendulum to clocks, but this claim was not made until after the publication

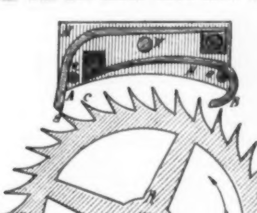


FIG. 25.

of the works of Huyghens. If Galileo had really solved this problem, the honor was taken from him through the negligence and idleness of his pupil Viviani, on whom he had founded many hopes. It is certain that the right to the priority of the discovery and to the gratitude of the entire world, belongs to Huyghens.

The escapement which Galileo had in view for applying the pendulum to, is represented in Fig. 5. The wheel *R* is furnished with teeth, which are locked against the piece *D* pivoting at *a*, and with pins designed to give the impulse to the pendulum by means of the pallet *P*. The arm *L* serves for unlocking the wheel from its position of rest, raising, on the return of the oscillation, the lever *D*.

Fig. 6 shows us the simple conversion which was necessary in clocks for the application of the new

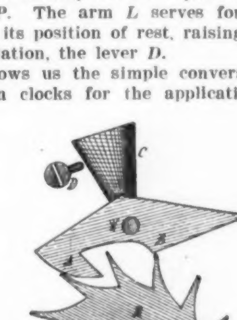


FIG. 26.

regulator. The verge *V* was placed horizontally, and the pendulum *B*, suspended freely to a wire, received the impulse by the intervention of a fork *F* forming one body with the verge. At the outset the fork did

not even exist. The pendulum was attached directly to the verge instead of through the fork.

A great step forward had been taken, but it was soon perceived that perfection was still far distant. The verge escapement necessarily communicated to the pendulum oscillations of varying extent, and as these oscillations were not of the same duration as Galileo had supposed, the adjustment varied materially with the intensity of the motive force.

Huyghens made his pendulum isochronous, that is to say, rendered its vibrations equal in duration, no matter what the arc passed over, by suspending it between two metal curves (cheeks) C, C', each formed by an arc of a cycloid, against which the suspending wire struck at each oscillation (Fig. 7). In the large oscillations the pendulum was thus shortened, and this shortening corrected the duration of the oscillation, but the exact application of the cycloid was difficult, if not impossible, in practice, and efforts were made to discover an escapement which would allow of small arcs of oscillation. The clockmaker Clement, of London, solved the problem in 1675 with his ratchet and recoil anchor escapement.*

In the interval other methods had been contrived, and efforts were made to correct the irregularities of the pendulum by adding a second pendulum. The escapement represented in Fig. 8 exhibits an attempt of this kind. The verge is again vertical and carries two arms D, D', which are each connected with a pendulum by a flexible wire. The two pendulums vibrate constantly in opposite directions.

Fig. 9 represents another escapement with two pendulums. These are fixed directly on two arbors, each bearing a pallet P, P', and a portion of a toothed wheel D, D', which connects them solidly together. These two pendulums also oscillate in opposite directions and receive the impulse alternately. This escapement was constructed by Jean-Baptiste Dutertre, master clockmaker of Paris.

Another arrangement is seen in Fig. 10. The pendulum is double, but has only a single bob. It receives the impulse by means of the double fork F. C, C are cycloidal cheeks, seen sideways, and designed, as stated above, to correct the inequality of duration in the vibrations.

In watches, a circular balance not affording a better result than the *régules* of clocks, and the pendulum not being applicable, it was necessary to seek for a different regulating system. The Abbé Hautefeuille had had the idea of attaching one end of a bristle to the plate, and the other to the balance near the arbor. The bristle was afterward replaced with a straight and very flexible spring, then by a spring bent in the form of a serpent; but still watches did not go much better.

Harrison, the celebrated English horologist, had recourse to two artifices, one of which consisted in giving to the pallets of the escapement such a curve that the balance could be brought back with a velocity proportioned to the extent of the oscillation. The second consisted of an accessory piece, whose action was analogous to that of the cycloidal cheeks of the clock.†

Huyghens sought to correct the irregularities of the vertical escapement in watches by increasing the amplitude of the vibrations of the balance. For this purpose he constructed the *pirouette* escapement (Fig. 11), in which a toothed wheel A, adjusted on the verge V, serves as an intermediary between this and the balance B, on the staff of which is a pinion D. By means of this construction he secured quite extended but very slow vibrations, which were still subject to all the irregularities proceeding from concussion and from the motive force.‡

About the same time, Dr. Hooke, of the Royal Society of London, contrived a different arrangement, by means of which he succeeded in abating the influence of concussion a good deal; but various other inconveniences prevented its adoption. In his invention, the 'scape wheel R (Fig. 12) was flat and of ratchet form. There were two balances B, B', engaging together and each bearing a pallet P, P', on its staff. The three arbors were therefore parallel. In our illustration, the tooth a of the 'scape wheel is operating the lift on the pallet P. When this tooth escapes, the tooth b will fall on the pallet P'. The recoil will be produced under the action of the two connected balances; then the tooth b will give the impulse in the opposite direction. This escapement is quite similar to the one for clocks represented in Fig. 9.

In 1674, Huyghens caused the construction of the first watch having a regulating spring; this spring was of spiral form. The merit of the invention was disputed by Dr. Hooke, the English scientist,* who claimed priority, as Galileo had for the application of the pendulum. This first watch with a balance furnished with a spring had a *pirouette* escapement, as described above.†

Huyghens, who had discovered and corrected the irregularities of the pendulum oscillations, did not give attention to those of the balance with its spring. It was only about the year 1750 that Pierre Leroy and Ferdinand Berthoud commenced studying the conditions of isochronism of the balance spring.‡

But the splendid invention of Huyghens was welcomed, like that of the application of the pendulum, with general enthusiasm. Without the spring and without the pendulum, no other escapement but the recoil was possible. A new path was opened for investigators. The clepsydras and hour glasses disappeared completely, and a second hand for indicating the minutes was added to the horary apparatus, which had been rendered capable of greater regularity in the rate.

The first dead-beat escapement did not appear till 1695. In the interval improvements of the verge escapement were attempted, but practice demonstrated that no arrangement was superior to the original.

We will notice some of these attempted improvements in clocks. Fig. 13 represents a verge escapement with a ratchet wheel, of which each pallet P, P', is borne by a different arbor. The two arbors are connected solidly together by the arms O, O'. One of the arbors carries the fork F, which transmits the impulse to the pendulum B. In the illustration giving a front view, the fork and the pendulum are omitted; the junction and the working of the two arms O, O', are represented.

A verge escapement of special construction is exhibited in Fig. 14. There are two wheels, one small, R', of ratchet form; the other R, larger, resembles the vertical wheel, but has straight and narrow teeth. The verge V carries the two pallets, and is pivoted in the diameter of the large wheel. The front view in the illustration will render the method of operation clear to the reader. The tooth a of the large wheel is operating its impulse on the pallet P, and the tooth b of the ratchet will meet the pallet P'. This pallet, after effecting its recoil, will receive the impulse of the tooth b. This escapement could not have given much satisfaction. It possesses no advantage, and is of more difficult construction.

In Fig. 15 we have a mechanism with two 'scape wheels R, R', gearing together. One alone is worked by the train, and it actuates the other in an opposite direction. They are both furnished with pins C, C', which act on the pallets P, P', arranged in the same plane on the verge V. The escapement is represented at the moment when the pin C' is operating the impulse, and this terminated, the locking will be effected by the pin C of the other wheel on the pallet P'.

The system represented in Fig. 16 has also two 'scape wheels R, R, but they are both actuated by the last wheel of the train A, and revolve in the same direction. The working of the escapement is still the same.

Fig. 17 presents a double-lever escapement, contrived by the Chevalier de Bethune, and applied by Thiot, a master clockmaker of Paris, in 1727. P and P' are the two levers or pallets, having each a distinct pivoting point. On the arbor V of the lever P is attached the fork which communicates the movement to the pendulum. The two levers are solidly connected together by means of the arms B and B', of which the first carries an adjusting screw, quite useful for modifying the angle of the opening of the pallets. The counterweight C is designed to keep the arm B' constantly pressed against the screw. The function is still the same. The recoil and impulsion are operated on the two pallets simultaneously. This escapement had some success, and was employed by a number of horologists, who modified it in different ways.

In Fig. 18 we have one of these modifications. The fork is borne by the staff of the pallet P', which allows of the omission of the counterweight C.

Fig. 19 represents the same escapement, but constructed with a complication, which could not have been of much value. The two levers are completely independent of each other, and act on a piece BB, on the arbor V of which is the fork. The counterweights c and c' maintain the arms bearing the rollers D, D', constantly pressed against the piece BB, which thus receives the impulsions. Two adjusting screws allow of regulating the escapement readily.

These different constructions were gradually abandoned to give place to the recoil anchor escapement, which was invented, as stated above, by Clement of London in 1675.

Fig. 20 presents the first arrangement adopted by this artist. The pallets are replaced by the inclined planes A and B of the anchor, which pivots at V on a staff, to which the fork is attached. The tooth a is leaving the inclined plane or lever A, and the tooth b is about to be locked on the lever B. Under the action of the pendulum, there will be a recoil of the wheel, as in the verge escapement. Then the tooth c will communicate an impulse in the opposite direction. With this new system of escapement, it was possible to increase the weight of the bob, while employing less motive force. The extent of the arc of vibration being less, a much greater accuracy in the rate was procured than with the vertical escapement. This new recoil escapement was not applied in France till 1695.

However, the oscillations of the pendulum still exceeding the extent in which they remained isochronous, the attempt was made to give the levers a form designed to secure this isochronism, which was already recognized as a prime condition for obtaining a precise adjustment.

Julian Leroy undertook in 1720 to determine the form of inclined plane suitable for rendering the oscillations isochronous. Ferdinand Berthoud pursued the same course and constructed the escapement represented in Fig. 21. We see the same inclined planes, A, B, as in the preceding construction, but the lockings are effected against the sides C and D, of which the form is to give isochronism to the oscillations of the pendulum. The tooth b is operating its lift, and the tooth c will be locked against the face C. After having effected its recoil, this tooth will become engaged by the inclined plane A, producing a new impulse.

In Fig. 22 we have the roof-shaped escapement, which allows of a heavier pendulum, and of which the anchor embraces a larger number of teeth. This arrangement led to the discovery of the fact that with long levers for the anchor, the friction was greater, and the recoil faces were worn more rapidly. It was doubtless contrived to enable the anchor to open and close more readily.

Under the name of the English recoil anchor escapement, a reduced roof-shape escapement, embracing a less number of teeth, was adopted. It is represented in Fig. 23. This appears to have had some success.

At present, the recoil anchor escapement is constructed in Germany in the economical form represented in Fig. 24, an arrangement met with in the American system of clocks. The anchor is formed of a single piece of steel bent in the desired form. Clocks furnished with this escapement have quite a regular rate. The resistance of the recoil compensates in some measure for the lack of isochronism in the vibrations.

Ordinary clocks requiring a greater motive force than that necessary for the better class of clocks, the tick-tack of the escapement is quite strong. Several methods have been attempted for deadening the noise; among them the arrangement represented in Fig. 25. The anchor is formed of two pieces A, B, adjusted on a plate H, pivoting at V. These two pieces in their arrangement represent exactly the anchor of the preceding figure. Their extremities working with the wheel, bend at the moment of the impact of the tooth, and the spring must be quite strong in order to immediately resume its natural position against the studs e, e.

In conclusion, we will refer to the employment made in our days of the recoil lever escapement in repeating watches. The lever (Fig. 26) is designed to reduce and regulate the rate of the small train of the striking part. It pivots at V and has a very rapid movement, of which the amplitude is rendered variable by means of the stud D, which limits the course of the fly C. This fly is a part of the same body as the lever and limits the angle which the latter has to describe. If the angle is large, the train moves slowly. If the teeth of the wheel can just pass, without the lever describing a supplementary arc, the train will proceed quite swiftly.—Translated from the Almanach des Horlogers.

TESLA DISCHARGE.—The superior discharging power of positive Tesla charges over negative ones has been confirmed by K. von Wesendonk. He used a water-spray collector placed 6 yards away from the point. The charge thus collected, after a few minor oscillations, was always positive. A negative displacement of the spot was never observed. The positive charge

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* This statement is erroneous, and as there are one or two other substantial errors in this article, which in general is accurate and valuable, it will be well to point out their probable source. Sully, an accomplished English horologist, settled in France, and the inventor of an escapement himself, published in 1717 a work entitled Règle Artificielle du Temps, now exceedingly rare, in which he speaks doubtfully of Clement as the originator of this escapement, and refers to Smith, a London clockmaker, who had also published a pamphlet, as the author of the statement. Berthoud, in his elaborate history, cites the statement in Sully's work and speaks with the same hesitation. More recently some of the French writers have turned these qualified remarks into an unconditional assertion. Now it is certain that Dr. Hooke was the author of the recoil anchor escapement as early as 1675, and that Clement was the clockmaker who constructed the clock in accordance with Hooke's designs. Sully and Berthoud both give the date as 1680, but it may have been earlier, but not before 1677, when Clement became a member of the Clockmakers' Company. The error of the French writers is the more remarkable, because both Sully and Berthoud in France, as well as Derham in England, in a work entitled "The Artificial Clockmaker," published in 1696, state that the invention was claimed by Dr. Hooke.—Note by Translator.

† The history of these different escapements will be better understood by remarking that they are far from being given in chronological order. For instance, Harrison's researches did not commence until half a century after the next invention described.—Trans.

‡ This description hardly does justice to the pirouette escapement, an escapement not described by modern horological writers, and unknown to the vast majority of watchmakers, though not on account of the facts alleged in the text. It was the first departure from the verge escapement, and as such important in tracing the course of scientific thought that has led to the present perfection. The earliest horological writer who described the escapement was probably Sully, who was of opinion that Huyghens contrived it as an application to watches of the principle of the seconds pendulum of clocks, then recently invented, and that it might have antedated the use of the spiral spring. But in reality this escapement was applied at the same time as the spiral spring, and was a part of Huyghens' system for producing isochronism. Sully was probably not aware of a description of the "pirouette watch," as it was termed, in the Transactions Philosophiques and in a memoir of the Académié des Sciences, from which it appears that Huyghens' principal object was the determination of longitudes at sea. This was nearly three-fourths of a century before that problem was definitely settled. Thiot, who wrote about the middle of the eighteenth century, gives an illustration of the escapement, with a description ascribing no imperfection. Berthoud, half a century later, commends it decidedly, and thinks that Huyghens would have succeeded if the handicraft of horology had kept pace with its science. Watchmakers were very prompt in adopting the spiral spring, but did not sufficiently appreciate the advantages of its accompanying escapement to incur the additional labor and expense. Its influence, according to Berthoud, was the opposite of that mentioned in this article. With the long arcs there was less danger of overbanking, and the recoil was reduced to a minimum, tending to the isochronism of unequal arcs. By comparing Figs. 4 and 11 in the text, it will be seen that Huyghens reversed the position of the wheels, the vertical wheel of the verge escapement becoming horizontal, and the contrate or crown form, which was used for the last wheel of the train, being adopted for the intermediate wheel.—Note by Translator.

* It was more successfully disputed by the Abbe de Hautefeuille, who prevented Huyghens from obtaining a patent on the ground of prior use; but this savant, like Dr. Hooke, was always on the alert for a new discovery before perfecting a former one, and did not derive any advantage from the application of the spring. Huyghens, who had been invited to France by Louis XIV., returned to his native Holland in 1681, and the spiral spring and its attendant escapement became common property. Dr Hooke's contrivance was a straight spring; but the English writers regard its principle as covering springs of any form. It is thus that the invention of the spiral balance spring is ascribed variously to each of these three scientists.—Note by Translator.

† It had the pirouette escapement and was called "the pirouette watch." Much confusion has been caused by dividing the invention of Huyghens, and regarding the escapement as a prior and independent contrivance.—Trans.

‡ Berthoud gives distinct credit to the priority of Huyghens' investigations. A condition which Huyghens did not study was the effect of temperature.—Trans.

in the air took some time to dissipate. The author obtained substantially the same results on reducing the primary spark-gap from 15 mm. to 8 mm. or even 5 mm. This shows that not only does the positive Tesla effect penetrate far into space, but it is largely independent of the voltage.—K. von Wesendonk, Phys. Zeitschr., August 1, 1903.

THE MAGNITUDE OF THE COAL INDUSTRY.*

THE story of coal mining and distribution is a wonder story. In every country there is something wonderful in regard to it, but nowhere else is this so true as in the United States. Within a few years the production has grown to figures which were deemed out of reach by persons in official position who made estimates only two decades since. We now occupy first place in point of output of coal in the world; we have distanced Great Britain and do twice as much as Germany, the third country in the list. One hears much of the anthracite trade in this country because the interest is concentrated and it is a domestic fuel, but it is nothing to be compared with the bituminous trade of the country, the tonnage of which will reach four times that of anthracite during the year 1903.

The production of coal in the United States amounted to something like 300,000,000 net tons last year, of which 37,000,000 tons was anthracite. In spite of the larger output of anthracite this year the bituminous holds its own, or within 5 per cent. The particular fact worthy of mention, perhaps, is that of our large home consumption. While Great Britain does a tonnage closely approaching that of this country, about 54,000,000 tons of her tonnage is exported. Our business is shown by the shipment of about 7,000,000 tons annually of all grades.

A recent government report showed the progress made in coal produced in the United States at decennial years from 1850 to 1900 to be as follows:

Calendar year	Tons of 2,240 pounds.
1850	3,358,899
1860	8,513,123
1870	32,863,000
1880	62,822,830
1890	140,866,931
1900	240,788,238

The total output of coal in the world is put at something over 855,000,000 net tons, and the three great countries are the United States, with 295,124,793 tons; Great Britain, with 246,942,985 tons, and Germany, with 150,742,267 tons. Great Britain, United States, Germany—the three Anglo-Saxon countries and the seat of intelligence, where industries are greatest; the Latins do not produce or consume coal to any like degree.

The growth in the production of bituminous coal in this country has been developed along the following lines:

	1869.	1879.	1902.
South	2,785,505	6,093,693	62,383,142
West	5,608,392	18,599,823	95,707,989
Pennsylvania	7,798,518	18,004,988	98,946,203

Phenomenal has been the growth in the tonnage from the States south of the old Mason-Dixon line. There the output has grown from 2,785,505 tons in the census year of 1869 to 62,383,142 tons in 1902, and the end does not yet appear, for the number of operations has nowhere multiplied so greatly in recent years as in West Virginia, Tennessee, Kentucky, and Alabama. The facilities for mining are the simplest, for the coal is above water-level, and the great railroad systems are only too ready to offer every opportunity for the development of the vast areas of coal land; in fact, it is stated that the one State of West Virginia contains a larger extent of coal than does Great Britain.

American mining is carried on so largely by drift mining at present that it is a marvel to the foreigner to find how cheaply, in a comparative sense at least, the coal is put on the railroad cars at the mine tipple. Abroad, the mine owner sometimes must go to a depth of 2,000 feet for his thin seam of coal, while in this country the drift into the side of a hill, on a seam of coal running up to 10 feet or more, is in no sense unusual. Shafts in some of the western coal fields are usual, but are not beyond a couple of hundred feet in depth, as a rule; they find seams up to 5 and 6 feet, and this is sold at very low prices, for the tonnage is dealt with in large quantity. There are slopes in the South to somewhat thinner seams, and the use of electric machines for cutting, transporting, and hoisting give some cheap results; one mine in Alabama recently turned out 1,663 tons in a day.

Anthracite mining is by shaft or slope, and within a few days it is learned that the Reading Company are to sink one of their shafts to a depth of 1,050 feet—it is now 900 feet—and four valuable coal seams have already been cut. Mr. Baer tells us that the cost of labor in producing a ton of hard coal has increased steadily in recent years. In 1866 it was 60 cents per ton; in 1900, $1.12 per ton, and in 1901, $1.29 per ton, and before the increase of 10 per cent. in wages in 1902 it rose to $1.37. The present cost of labor per ton of coal mined is unofficially stated to be about $1.50 per ton, and this on all the coal—large and small.

It is well to remember that not all coal mined is shipped; 6 per cent. of the soft coal and 12 per cent. of the anthracite is used at and about the mines for steam raising, or for local uses. Of the bituminous coal shipped to market, about one-half is used for railroad and steamship supply, and coke took up 39,600,000 tons last year.

Our foreign trade, apart from the countries north and south of us, has not amounted to much in recent years. We were doing something in 1901, and then came the higher figures, due to our industrial activity and other causes. Now that prices of bituminous coal have been reduced to something like normal figures, there is again opening up the possibility of entering at places in competition with British coal; what we need is vessels to carry it at a fair rate of freight, and then we can accomplish another feat in the long list of American invasions. One thing that is eminently satisfactory is the fact that the American navy, no matter in what part of the world it is located, now has its furnaces fed with the product of American mines. The necessity of this was fully shown in the recent Spanish-American war; the trip of the famous battleship "Oregon," from the Pacific to the Atlantic, was made on all sorts of coal picked up on the way at very high prices, but her engineer made the best of time after he got some Virginia coal.

Pennsylvania is the only State wherein both grades of coal are mined, barring Colorado, which has turned out less than 100,000 tons of so-called anthracite.

Coal is carried by rail great distances, from its point of production to place of use, and bituminous coal is conveyed by water at very low rates. This coal is taken from Pittsburg to New Orleans at 50 cents a ton. Bituminous coal is carried at less rates because of its distance from market, and because it is all one grade and does not need any extra handling at the point of shipment, or at the point of loading.

It may be said of bituminous coal that the price paid for digging represents largely its cost; but this is not so in regard to anthracite. Of this coal, as it is sold to consumers, one might truly say it is a manufactured article. The mere wages of mining it are but a modicum of the cost of the domestic sizes per ton, on board cars at the foot of the breaker, ready to start on its way to the consumer. One may open up a soft coal operation for one-twentieth (or less) the cost of an anthracite colliery, with its breaker, etc.

The tonnage dealt in at certain cities shows the extent of the industry, though in some places all the tonnage referred to is not consumed there. The figures show the importance of the coal business to these cities. Thus we have the great lake ports, with Buffalo, 8,100,000 tons; Cleveland, 5,200,000 tons; Toledo, 6,545,000 tons; Erie, 1,500,000 tons; Ashtabula, 1,400,000 tons; Milwaukee, 1,600,000 tons; Duluth-Superior, 3,700,000 tons, and Chicago, 9,000,000 tons. On the Mississippi and its tributaries we have Pittsburg, 25,000,000 tons (part of which goes to lower river ports); Cincinnati, 3,250,000 tons; St. Louis, 4,400,000 tons; Louisville, 1,420,000 tons, and New Orleans, 2,300,000 tons. On the Pacific coast there is Seattle with 910,000 tons, Tacoma with 400,000 tons, and San Francisco with 1,500,000 tons. There has been loaded at the shipping ports on the Atlantic: Hampton Roads, 4,700,000 tons; Baltimore, 4,500,000 tons; Philadelphia, 12,000,000 tons, and New York ports, 16,000,000 tons. Boston gets 4,500,000 tons, and Providence 1,700,000 tons. It is said that the total receipts at London, England, amount to 15,000,000 tons a year, for all uses—locally and shipping.

The sizes of anthracite are more numerous than many persons suppose, as the coal comes up out of the mine in a very mixed condition, containing all manner of sizes, with dirty and boney coal. As it passes through the breaker, where it is screened and sized, it goes off in the following sizes: Lump, steamboat, broken, egg, stove, chestnut, pea, buckwheat, rice, barley, mustard, culm. One important company make the following report on sizes as made at the breaker: Larger than pea, 64.31 per cent.; pea, 14.33 per cent.; buckwheat, 17.47 per cent.; rice, 3.85 per cent.; barley, 0.02 per cent. The washery product of the culm bank, reported by the same concern, shows: Stove, 3.11 per cent.; chestnut, 8.24 per cent.; pea, 18.48 per cent.; buckwheat, 39.40 per cent.; rice, 27.11 per cent.; barley, 2.91 per cent.; culm, 0.07 per cent. Very few except the older banks yield any of the stove and chestnut. Pea began to be largely used in 1867, buckwheat in 1878, and the smaller sizes about 1895. The royalty on anthracite, where mines are leased, runs at from 25 to 50 cents, as to size; average about 31.25 cents. The royalty on culm bank ranges between 10 to 15 cents.

On the Great Lakes the boats take coal 1,000 miles for 30 cents a ton, and an average cargo of 7,000 tons is put in one of these readily in a day, and unloaded in about the same length of time, the machinery and facilities for doing so on the lakes being a great deal better than those on the Atlantic coast. Cars loaded with 40 tons are lifted bodily and their contents dumped into the vessels. The four largest vessels on the Great Lakes are: The "James J. Hill," the "John W. Gates," the "William Edenborn," and the "Isaac L. Elwood." These are sister ships, owned by the United States Steel Corporation, and their dimensions are 498 feet over all, 478 feet keel, 52 feet beam, 30 feet depth. They have each carried as much as 8,400 gross tons of iron ore on an 18-foot draft. There are a hundred or more steamers of 5,000 to 7,000 gross tons capacity in the lake service, and, of course, their dimensions are proportionately smaller than the ships above referred to.

The combined registered tonnage in the foreign trade at New York, Boston, Philadelphia, Baltimore, New Orleans, San Francisco, and Puget Sound for the entire year 1901 was 18,868,808 tons entered, and 18,487,246 tons cleared, or somewhat more than half the total tonnage reported for the Great Lakes during seven months of 1902. A further analysis of this enormous total showed that 14 ports each report arrivals and clearances of 1,000,000 tons and over. Five ports—Chicago, Milwaukee, Duluth, Cleveland, and Buffalo—each show clearances of 2,000,000 tons and over. The combined arrivals of these five ports were 11,421,099 tons, and the clearances 11,455,544 tons. As an example of quick loading on the coast, it may be stated that the "Thomas W. Lawson" loaded 7,523 tons of bituminous coal at Curtis Bay pier of the Baltimore & Ohio Railroad in ten hours, 6,000 tons being loaded in six hours.

There is no class of labor which is so well paid for the service rendered as the coal runners; the main trouble of short time is due to the disinclination to do more than a certain quantity in the month. Any one with experience along this line, in any country, will indorse the opinion that this is so with the average worker in the mines. It is this which makes the average number of days worked in the course of a year as low as it is, within recent years at least. With the improvement in the general industrial situation there has been the opportunity for a greater number of days per week, month or year, but one does not find that the net result was what was expected, for the reason above stated. With many, the desire is for a certain sum to be realized in as short a time as possible, thus leaving more time for pursuits in other lines of pleasure or profit.

The number of employes in mining is put at 147,000 in the anthracite region, and 350,000 in the bituminous districts. The number of days worked in the soft coal mines have been about 235 in the year. In the anthracite region 98,434 men and boys are employed inside the mines, and 49,217 employed outside. In the bituminous fields of Pennsylvania, the number employed inside is 95,562, and 22,040 employed outside, making a total of 265,253 employes in the one State of Pennsylvania, and indicating its importance in the coal industry. Much soft coal is now mined by machinery, and the number of tons so mined in the United States in 1901 was 57,843,335 tons, and perhaps reached 70,000,000 tons this year.

Coke making is a great industry, as an adjunct to the coal business. The report for last year shows 39,604,000 tons of coal used for this purpose; the yield of coke being 25,401,730 net tons, or, say, 64 per cent. The number of ovens at the close of the year 1902 was 69,069. The three principal States are Pennsylvania, Alabama, and West Virginia, in this order:

	Tons coke made.
Pennsylvania	16,499,910
Alabama	2,552,246
West Virginia	2,516,505

—with the average cost at ovens put at $2.49 per ton.

One need not "view with alarm" the control of the coal supply, of which there is a great deal said in certain quarters. Experience teaches us that the prices are kept at a fair rate, all the time, instead of wildly fluctuating rates. Many users of coal can remember that prices have varied $1 or more a ton in a year, during what were termed normal times, when the individual or small operator was in full force. One could not tell if his neighbor was getting a supply at cut rates, and for this reason his cost sheet would vary from that of the user who was doing the very best that his plant could do. An evenness in prices is far better, for it puts all on an equal basis, so that the ingenuity of reducing cost must be developed along more scientific or mechanical lines, and not be a subject of cut rates on coal. Not that all coal is capable of the same results, but the cost being even, or nearly so, a great deal better opportunity for fairly competitive work is afforded. The most economical smoke consumer, to the concern which uses soft coal, is a well-paid and intelligent fireman, and this grade of fuel is being burned to-day in many places without being a nuisance to the neighborhood in which it is used, simply from the fact that it is handled intelligently in the fire room.

* Extracts from an address before Modern Science Club of Brooklyn, by F. E. Saward, editor of the Coal Trade Journal.

RAINFALL OF GREAT BRITAIN.

AT an ordinary meeting of the Institution of Civil Engineers, Sir William H. White, K.C.B., president, in the chair, the paper read was "The Distribution of Mean and Extreme Annual Rainfall over the British Isles," by Hugh Robert Mill, D.Sc., LL.D.

For the purpose of this discussion of the subject the author had employed the large collection of records of rainfall brought together by the late Mr. G. J. Symons. The records of rainfall kept up for 70 consecutive years at Chilgrove, Nash Mills, Orleton, Boston, and Kendal were discussed so as to compare the mean rainfall of various periods with that of the whole. The averages of the variations of the means of all possible groups of 10, 20, 30, and 40 consecutive years from the mean of the whole, expressed as a percentage of that mean, were as follows:

10 years.	20 years.	30 years.	40 years.
4.7	3.4	2.2	1.7

The mean of 30 years thus appeared to be subject to very little more variation from the mean of 70 years than was the mean of 40 years; and therefore a period of 30 years was sufficient to give a close approximation to the mean rainfall of a much longer period. It was also shown that the 30 years 1870 to 1899 gave, on the whole, a mean rainfall nearer to the true mean in all parts of the country than any other group of 30 years available for the purpose.

The 380 stations yielding perfect records for the 30

years, 1870 to 1899, were not sufficiently uniform in their distribution to serve as the basis of a rainfall map, and were therefore supplemented by the records of 668 stations, which were complete for at least 20 years out of the 30, these values being reduced to the equivalent 30 years' means by the usual method. A very few shorter records, also reduced to the 30 years' means, were used for parts of Scotland and Ireland. The accuracy of the individual records was secured by using only those which had been tested and published in "British Rainfall" year by year, and also by the critical examination of the figures as set out in their proper places on a map.

Isohyetal lines, or lines of equal rainfall, were drawn upon the map strictly in accordance with the figures, and without making use of any hypothesis, e. g., as to the effect upon rainfall of the height or exposure of the land. These lines were drawn for every 5 inches of rainfall up to 40 inches, for every 10 inches from 40 to 60, and for every 20 inches for higher falls. With the exception of a few small specified areas, the resulting map gave as full and accurate information regarding the distribution of mean annual rainfall over the British Isles as its scale admitted. Its value lay in that it was based exclusively on definitely ascertained facts of observation, so that it might be used for the purpose of deducing the relation of rainfall to the altitude and configuration of the land or to any other physical features.

The map showed that a mean rainfall under 25 inches occurred in three places: (1) a very narrow strip round the Moray Firth, (2) a triangular area about the Thames estuary, and (3) a large portion of east central England south of the Humber. A rainfall between 25 and 30 inches prevailed over more than one-third of the surface of England, occupying the whole center of the country, also over a strip along the east coast of Scotland, and in a small patch around Dublin. The rest of Scotland and Ireland received more than 30 inches of rain, and more than 30 inches also prevailed in four large and several small isolated portions of England. The larger of these were (1) the whole northwest of England, including all the land more than 500 feet in elevation from the Scottish border to beyond Derbyshire, (2) all Wales, together with a strip of the bordering districts of England, (3) the peninsula of Cornwall and Devon with prolongations eastward along the Cottswold Hills, along the Marlborough Downs, and over Salisbury Plain, and (4) the higher land and the edges of the plain to leeward of it in the Weald district of Kent, Surrey, and Sussex. The smaller patches of rainfall over 30 inches occurred on the Cleveland Hills, the North York moors, and the Yorkshire and Lincoln wolds. In all these cases there was a distinct, though not an identical, relationship between the amount of rainfall and the height and configuration of the land.

The parts of England receiving a rainfall of 40 inches and over included (1) the Lake District with the east of Lancashire and the west of the North and West Ridings of Yorkshire, the center of maximum fall exceeding 100 inches around Seathwaite, (2) the whole of Wales except Anglesea, culminating in an area with over 100 inches round Snowdon, (3) almost all of the peninsula of Cornwall and Devon, centers of heavier fall occurring on Exmoor, Bodmin Moor, and Dartmoor.

The data were rather less satisfactory for Scotland and Ireland. In Scotland it was clear, however, that a rainfall over 40 inches was confined to the western half, the maximum (which exceeded 80 and sometimes 100 inches) occurring in the Western Highlands, but not extending to the coast except perhaps in Skye. In Ireland the mountain groups of the east, and the whole of the county west of the Shannon and the Foyle received more than 40 inches and the fall exceeded 50 inches in the west of Kerry, Galway, and Mayo.

While a distinct relation appeared between the amount of rainfall and the configuration of the land, taken in conjunction with its elevation and exposure, the author thought that no definite numerical relation between amount of rainfall and mere height above sea-level could be made out.

The average annual rainfall had been calculated by measuring the areas between successive isohyetal lines on the map; multiplying the area of each zone by the average fall within it estimated from the figures on the map, adding all the resulting volumes together for each of the great divisions and dividing by the total area of each.

The extremes of annual rainfall were discussed by taking out the figures for the driest and wettest year of the period 1870-99 from the records of 290 stations, selected so as to be as nearly as possible uniformly distributed over the country. At 145 of these stations 1872 was the wettest year, at 92 stations 1887 was the driest year, no other year having anything like so many extremes in either case. The average of the wettest years at all stations was 3.5 inches higher than the average of the year 1872 at the same stations; the average of the driest years was similarly 2.5 inches lower than the average of 1887. It is shown that 1872 was probably the wettest and 1887 probably the driest year of the nineteenth century for the British Isles as a whole. Rainfall maps of 1872 and 1887 were prepared and found to show a relative distribution of rainfall substantially similar to that for the 30 years' mean.

The average rainfall of each of the two years had been calculated from the maps for each of the great divisions, and the results, to the nearest half-inch, together with that for the 30 years' means, were as follows:

Period.	England. Inches.	Wales. Inches.	Scotland. Inches.	Ireland. Inches.	British Isles. Inches.
Mean 1870-99	31.5	49.5	47.0	42.0	39.5
Year 1872	45.0	74.0	62.5	52.0	53.0
Year 1887	23.5	36.5	39.5	32.0	30.5

The excess of rainfall in 1872 was 34 per cent and the deficiency of rainfall in 1887 was 23 per cent of the average fall for the British Isles as a whole. The rainfall of 1872 for England and Wales was almost exactly double that of 1887.

THE SLEEPING SICKNESS.

SOME very recent investigations have again attracted attention to the "sleeping sickness," and studies have been made in the country of its origin in order to determine its nature, its mode of propagation, and the extent of its ravages. There is no exaggeration in saying that civilized nations are confronted by a scourge that will offer a powerful barrier to the work of civilization in Africa.

FIG. 1.—THE TSETSE FLY. (GLOSSINA MORSITANS.)

What, then, is this sickness, of which the effects are so terrible? It is a cerebro-spinal meningitis, which, instead of being produced by the bacillus of tuberculosis or meningococcus, which are microbes, that is to say, algæ, is caused by an animal, a protozoon, the *Trypanosoma ugandense** (Fig. 2). Some formidable diseases, such as the "surra" and the "nagana," which decimate the herds of cattle in a great part of India and Africa, are caused by allied parasites. The sleeping sickness, which has long been known upon the western coast of Africa, has been called, according to the region, by various names, all signifying "to sleep;" in Loango and Bangala, *koulala;* in Pahouin, *auyo;* in Yolof, *nelawan;* and in Bambara, *sonorhodimi.*

The disease, whatever be its local appellation, always presents the same symptoms. The victim gradually loses his animation, becomes morose, has a tendency to isolate himself and ceases to speak spontaneously, while his eyelids close of themselves and cannot be kept open without an effort that wrinkles his forehead. Somnolence is almost constant, but very slight, and it suffices to call the victim in order to awaken him. But the general state gradually becomes aggravated, the bodily functions are badly performed, the sleep becomes profound, and the victim imperceptibly passes from life to death.

* Up to recent years, the sleeping sickness has been attributed to a microbe. Such has been the conclusion of the various Portuguese and Belgian commissions. It is not a microbian disease, however.

The greatest danger presented by this terrible disease is the facility, and, it might be added, the rapidity with which it is propagated. We are going to show by what a curious association of biological phenomena the sociological ones are influenced and the effects that result therefrom upon colonization. The sleeping sickness, originally confined to the west coast of Africa, has spread to South America and the Antilles. We shall see further along why it has not become implanted in these countries by convoys of slaves. But sight must not be lost of the fact that before the epoch of the great European conquests in Africa, the interior of the country, divided into an infinite number of small kingdoms, lived in the most complete anarchy, and in a state of continual war.

Normal and regular relations between tribe and tribe were therefore exceedingly rare. Such a situation prevented people afflicted with the sleeping sickness from going to a distance to carry the germs of the disease. After the Europeans had entered Africa, they enslaved the petty kings and prevented the local wars that thwarted their economic projects by rendering commerce and agriculture almost impossible. When, therefore, peace prevailed over vast regions, and it was possible for the blacks to roam over them without danger either for trafficking or for offering their services as boatmen, porters, soldiers, or laborers, it was possible for the sleeping sickness to spread without trouble. Migrations, to which primitive peoples are so much addicted, carried it to the heart of Africa with the result of its progressive invasion of all the countries inhabited by the blacks. The region of Loango, the right and left banks of the Congo as far as to the Belgian station of New Antwerp, and those of the Oubanghi as far as to the height of Banghi, may be considered as the foci of infection, since the disease is there in an endemic state. It has also ascended the Kassai and reached the Manyema and Ouganda. Upper Egypt is threatened, as is also English Eastern Africa, and there is nothing to permit of foreseeing where the formidable trypanosoma will stop, since it attacks the Arabs and does not spare the European, there being no immunity of race.

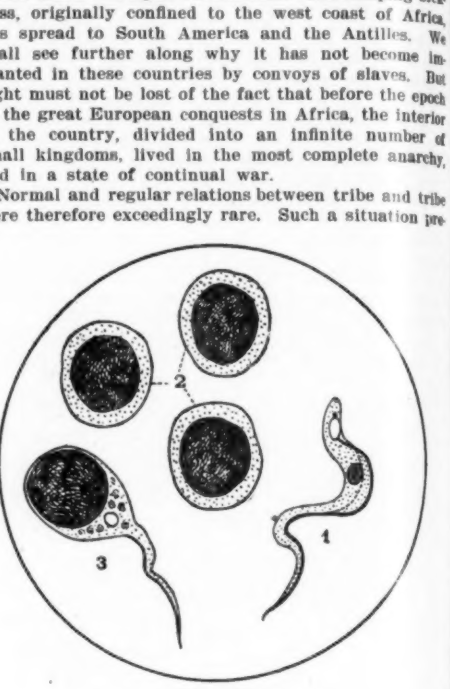

FIG. 2.

1. Trypanosoma Ugandense. 2 and 3. Cells of the cephalo-rachidian liquid.

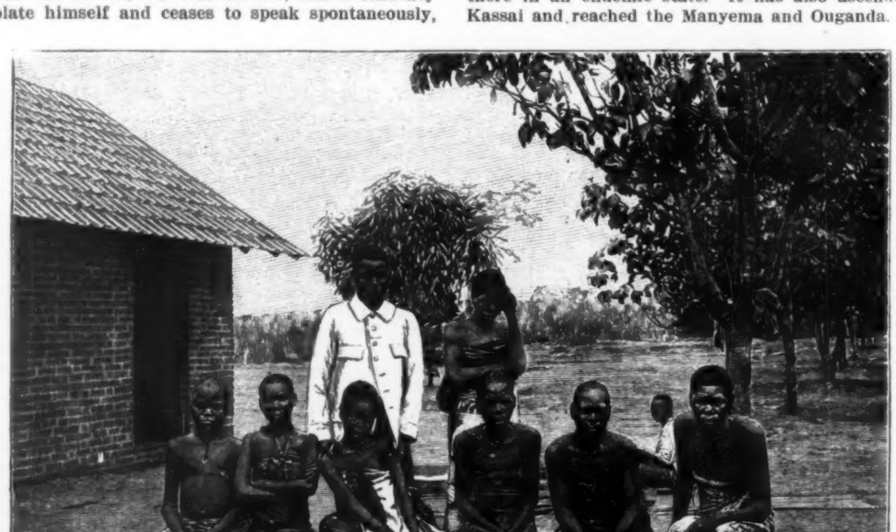

FIG. 3.—NEGROES ATTACKED WITH THE SLEEPING SICKNESS.

Although the sleeping sickness is sufficiently well known as regards its most general characteristics and habitat, the same is not the case with respect to its mode of propagation, as to which several theories have

been propounded. At all events, the following are the results of a mission recently sent to Africa by the Minister of Public Instruction and the Colonial Institute of Medicine. Dr. Brumpt, the head of such mission and preparator for Prof. R. Blanchard, had collected a large number of facts upon the question during the course of a preceding mission directed by Viscount du Bourg de Bozas, who has traversed Africa from Djibouti to the Congo. It results from all the observations made that the sole agent of transmission that can really be criminated is the "tsetse" fly, the *Glossina morsitans*, which is very common from the Nile to the mouth of the Congo. In the Antilles, to which it has been carried, it has never been possible for the disease to become acclimatized, since the tsetse does not exist there. In Africa, on the contrary, the insect swarms along the rivers, and the boatmen and travelers are continually exposed to its sting. Of a fickle and instable character, it stings ten persons before sucking the blood of a single one—an excellent condition for the transmission of the trypanosoma from one to another. Dr. Brumpt has discovered the method of evolution of its larvæ, which are viviparous and are deposited in a humid medium, such as earth and dung, upon which, however, they do not feed. The perfect insect appears six weeks later. In all the persons attacked it has been found that they had made a more or less prolonged stay at the waterside, in order to engage in fishing, and where they became infected with the trypanosoma. The period of incubation of the disease is variable, and may reach five years. In certain regions, the patients are treated by removing from them certain ganglions that have become hypertrophied, but the value of such treatment has not been experimentally verified. In most cases the victim continues his manner of life up to the moment at which he no longer awakens from his somnolence, but slowly passes away in the bosom of his family. More fortunate are they who are treated in hospitals belonging to the administration or to the missionaries. Figs. 3 and 4 represent two groups of patients. In the latter, Dr. Brumpt and Dr. Trautmann, director of the health service at Brazzaville, are seen puncturing a patient in order to ascertain the presence of the trypanosoma, while in the former is seen a young patient who fell asleep while the photograph was being taken. Fig. 5 shows a woman who has reached the last degree of physiological suffering. The stupid expression of her face, the general lassitude, and the indifference to everything that surrounds her show that the unfortunate Sapata has but a short time to keep awake.

Thus, then, has the civilizing rôle of European nations been unexpectedly curtailed by the formidable extension of a disease which, if a remedy is not found for it, will simply render the economic future of Africa questionable. It is permissible to hope, however, that the researches of modern science, and particularly those that Dr. Brumpt and Dr. Wurtz, of the Colonial Institute of Medicine are pursuing, will indicate a treatment analogous to those that permit of combating malarial and yellow fever. The three negroes taken by Dr. Brumpt to France, and who are attacked with the sleeping sickness, will serve as subjects for experimentation. Moreover, inoculations of rats, guinea pigs, and monkeys have already been made, and we shall doubtless have an opportunity in due time to give the results of the interesting experiments upon them.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

FIG. 4.—EXAMINATION OF THE BLOOD OF A PATIENT.

Cemented Brass Wire.—The so-called cemented brass wire, which can be drawn out into the finest threads, is obtained by laying round copper rods about 60 centimeters long and 26 centimeters in diameter into an iron box in such a manner that they do not touch. On the bottom of the box is granulated zinc and sal-ammoniac. When the box is heated, zinc vapors will arise, which combine with the copper, and change the latter superficially into brass. The rods should be turned so as to get a uniform brass coating. In this manner copper bars are obtained which are practically plated with brass, and can without difficulty be drawn out into very fine wires that have the appearance of brass, but exhibit the red color of copper in the cross section.—Metallarbeiter.

A BRITISH SEED-TESTING STATION.

By the English Correspondent of the SCIENTIFIC AMERICAN.

THE establishment of a seed-testing station in Great Britain is of quite recent date. In the summer of 1900 a departmental committee of the Board of Agriculture investigated the varying conditions under which seeds were sold in the country. The result of these investigations was to recommend the establishment of a seed-testing station, much on the lines practised and brought to such a high standard of efficiency in the United States and Germany.

FIG. 5.—A NEGRESS WHO HAS REACHED THE PERIOD OF THE SLEEPING SICKNESS.

Immediately after the publication of this report, a station was established in Lancashire by private enterprise. The work was carried out by Mr. J. Stewart Remington, and he has built his laboratories at Aynsome, Grange-over-Sands.

The station is complete with all the most modern appliances, and it is now one of the foremost stations of its description in England. The buildings comprise a germination room, purity room, and other research laboratories.

The seed laboratory is fitted with microscopes, microphotographic apparatus, and complete collections of weeds and seeds, not only such as occur at home, but also several foreign weeds, such as are found in German, Scandinavian, American, and Canadian samples.

Several systems of germinators are provided, comprising three large ones of the McLaren patent perfect germinator type; two Rodewalds, as used by many of the German seed control stations; one large Jacobsen incubator, as used by the Danish stations; a large number of small ones on the Coldewe and Schoenjahn's system, as well as a number of others. Further apparatus consists of seed sorters, purity testers, barley germinators, experimental malt-kiln, working by electric heating; Vogel's diaphanoscope, farinometer, Runge liter-weight scale, Svolof seed coat crusher, analytical balances, sieves, and a large quantity of physiological apparatus.

A small laboratory is set apart for water analysis and bacteriology, while another room is reserved as a calculation room, and is also intended to receive the chemical balances. In the ground immediately outside the large laboratory, there is a greenhouse for pot experiments on soils, manures, etc., as well as another laboratory, measuring 32 feet by 32 feet, for botanical work only.

On the south side of the farm, attached to the station, is a model dairy, built on the most perfect lines possible. It is quite separate from the rest of the farm buildings, and consists of a churning room, butter room, room for washing the dairy utensils, and a heating room, so as to obtain the most desirable temperatures at any season of the year for the production of butter.

It is essential that farmers, when sowing a crop of seed, should know the purity and germination capacity of the seed being used. For the purposes of testing, it is necessary to submit a sample withdrawn promiscuously from the bulk. Further, it is of importance to have an idea of the size and weight of the seeds in a sample, as large seeds contain more nourishment for the embryo, and therefore will produce larger and more vigorous plants in the same time than small seeds. Besides, large plants are better able to resist the attacks of fungi and insects. First, then, with regard to the purity of the seeds: The contents of a sample of seed may be grouped under three heads: (a) pure seeds of the species stated; (b) other seeds than the species stated on the label; (c) rubbish.

In testing, a small quantity of seed is carefully weighed on the chemical balance. It is then sifted through sieves of different mesh, so as to separate it into its ingredients. These are then spread on a sheet of white paper or piece of glass, and any impurities which may have escaped the sieves are separated out by hand with the aid of a magnifying glass. The total quantity of pure seed is then weighed, and its relation to the original amount taken is expressed as a percentage.

(b) The other seeds present in a sample may be those of other farm crops, or they may be weed seeds. In the former case, the other seeds may have a certain value, but when weed seeds are present, they are worse than useless, for they are positively injurious. The quantity of other seeds present in a sample is also expressed as a percentage.

It is further highly desirable that the names of the species occurring, or at least, the number of different species present in the sample, should be known.

(c) Rubbish is a general term applied to non-living and therefore harmless material in the sample, including under that category dust, dirt, sand, chaff, broken seeds, etc. The quantity present is expressed as a percentage. Although rubbish in a sample is harmless when cast on to the ground, it yet constitutes bulk, and the farmer pays for what is not seed.

In most samples there occur some small, imperfectly ripened seeds showing a greenish tinge; or some of the seeds, instead of having a plump exterior, are shriveled and are different in color from the usual type; or certain of the seeds are slightly injured by the machinery in the process of cleaning; or in the case of grasses, where the true seed is inclosed in husks, the embryo is quite rudimentary, although presenting at the same time a fair exterior. While all such seeds have very little chance of germinating, and might by judicious cleaning be removed, still they cannot be fairly regarded as impurities. It is better to include them under pure seed, and allow their fate to be settled by the germinative test.

While the color, brightness, and characteristic smell of the seeds in a sample are of value as indicating their age and soundness, and therefore give some idea of their capacity to germinate, still the last point can be settled much more satisfactorily by actual trial. For this purpose a number of pure seeds, separated as described above, are taken, usually 400 for small seeds and 200 for large seeds (a small number not giving such correct results), and these are tested on various materials, such as blotting paper, asbestos, or on porous tiles in machines especially devised for the purpose, due regard being had to the proper degree of moisture, temperature, and ventilation, that method being chosen which gives the best and quickest results for each kind of seed. The seeds are examined at regular intervals. Those that have germinated are counted and removed, and at the end of the test the total number of seeds which have germinated is known, and the result expressed as a percentage. This is known as the germinative capacity, and in certain kinds of seeds may be as high as 99 per cent. The time allowed for the germinative test depends upon the kind of seed and the method employed.

But whatever be the method used, it is important to know the rapidity of germination or the percentage of the seeds which germinate during the first few days of the test. This is known as the germinative energy, and gives an idea of the uniformity in character of the sample.

When the purity and germination capacity of a sample are divulged, the farmer is enabled to ascertain its real or utility value. This is expressed as the product of the purity and germinative capacity divided by 100. If, for example, the purity of a seed is 95 per cent, and its germinative capacity 90 per cent, its real value is $95 \times 90 \div 100$, or 85.50 per cent. That

is to say, in every 100 pounds of seed which the farmer buys, only 85½ pounds can be expected to grow and produce plants. Knowing the real value of his seeds, a farmer can therefore calculate the proper amount of commercial seed to sow per acre, and can at the same time compare the merits of two different samples which may be offered at the same price. For instance, he is offered two samples of red clover. One has a purity of 88 per cent and germinates 96 per cent; the other has a purity of 90 per cent and germinates 92 per cent. The price of both is the same. The real value of the first is $88 \times 96 \div 100$, or 84.48 per cent; the real value of the second is $90 \times 92 \div 100$, or 82.80 per cent; therefore the first is the better article for the money. It should, however, be clearly borne in mind by farmers that a sample of seed will not give so high a germination when sown in the field as when tested in the laboratory. In the field the seed has to contend against such difficulties as the want, or the excess, of moisture; too slow a temperature, want or excess of covering, attacks of fungi and insects, grubs, etc.; consequently at least 5 per cent of the pure seed should be sown to make allowance for these defects. Besides, in the case of clovers and other leguminous seeds, what are known as hard seeds occur. These can easily be germinated in the laboratory, but in the field their germination may be protracted. The average size and height of the individual seeds in a sample are of great importance. The fact that a big fully-developed seed will produce a stronger plant than a small one, makes it desirable to state the weight of a single seed. Two lots of 200 are counted and weighed, and of the average of both lots the weight of a single seed is calculated. These two lots of 200 seeds, it should be added, are not selected in any way, but are taken at random from the pure seed. As there is no weight in ordinary use small enough to express the weight of a single seed, recourse is had to the metric system, and the weight of a seed is expressed in milligrammes, one milligramme being equal to 1-28,350 of an ounce avoirdupois.

Knowing the average weight of one seed, it is easy therefore to calculate the number of seeds in a pound. Knowing the purity of his seeds, the germinative capacity, and the average weight of a single seed, and therefore the number of seeds in a pound, and knowing at the same time what space to allot to each individual plant in the field, the amount of seeds to sow per acre becomes merely a question of arithmetic to the intelligent farmer.

The purity room at the Aynsome laboratories is fitted with every known apparatus by which the purity of the seeds can be rapidly and correctly estimated. The germinators are of a special type. All the best appliances of this description in vogue at the continental stations have been tested, and the best features of each apparatus have been evolved and incorporated into one special contrivance. All the germinators in use at the Aynsome laboratories are electrically heated. In the incubator are placed a series of resistances. Any heat can be quickly obtained by passing the current through any respective resistance, which is, of course, raised to incandescence. The advantage of this practice is that any temperature can be easily and quickly gained and maintained. Furthermore, there is no possibility of the air in the germinator becoming vitiated, as with oil or gas heat, and the germination of the seed is not impeded in any way, as would be the case if hot foul air came into contact with them. In this manner is obtained complete control over moisture, heat, and air, the three most important requirements for successful germination.

For instance, moisture is absolutely indispensable, because the foodstuffs contained in all seeds, surrounding the quiescent germ, must be dissolved and absorbed by the root and shoot. Air is essential, in order to permit the process of vitalizing in the seed. The elongation of the root and shoot is another form of motion, and the force necessary to produce it is caused by the absorption and consumption of the oxygen of the air.

In the purity room all the samples of seeds submitted for testing purposes by farmers are submitted to an exacting test, and then purity percentage ascertained by the utilization of sifters and microscopes. For the sifting operations a number of delicately-contrived apparatus are employed. For instance, for the rapid estimation of the purity of the seed under examination by mechanical means, two ingenious appliances are used. There is a shoe-shaped funnel at one end of the instrument, in which the seed is placed. A small wheel is then revolved, and this seed is passed upon an endless band beneath a powerful microscope.

In every purity test two smaller quantities of seed are selected from the submitted sample, and are weighed exactly to the milligramme. This is then sorted, the different seeds, such as good seed, dead seed, weed seed, rubbish, etc., being divided into individual lots, and the purity percentage of the sample then determined. The seed is sifted by a mechanical sifter comprising a spindle working on an eccentric attached to the sieves, and a wheel. When the latter is set in operation, the sieves are submitted to an oscillating motion to and fro, by the eccentric movement, and the seeds in the sieves are graded according to the size.

The incubation or germination of the seeds is the most difficult part of the examination. The heat must be maintained at even temperature, and this has been found to be the safest at 68 deg. Fahr. In some instances, however, the seeds while in process of evolution are transferred from the incubator to another heated to 86 deg. Fahr. for six hours daily. In those cases where the seeds are counted for the purposes of germination, care has to be exercised that they represent the average character of the sample so far as concerns size, color, and general development. Two or three duplicators of 200 seeds are each superposed on blotting paper or sterilized sand, and then inserted into the incubator. A predetermined scale of time for germinating has been drawn up for various seeds, varying from ten to twenty-eight days. Should the seed take longer to germinate than the time allotted for its respective nature the test of that particular seed is discontinued. Rapidity and uniformity of germination are also carefully recorded, so that a report as to the germinative nature may be made, since it is those seeds which respond to this germination test that are the best. Should the seed be fresh and good, the greater bulk of it should germinate quickly. A scale of times has also been devised in connection with this germinative energy test, ranging from three days for cereals to ten days for certain grasses.

As the utilization of suitable fertilizers also figures largely in the most successful cultivation of seeds, a pot trial house is provided. Herein are carried out trials to determine the manurial requirements of seeds to be grown in any soil, due regard being made for the nature and condition of the soil in which the seed is to be planted. In this trial pot house are also demonstrated leading truths in the physiology of plant life.

TESTING THE SOUNDNESS OF CEMENT.

In an interesting paper read before the American Society for Testing Materials, Mr. R. W. Lesley remarks that while a good cement must have strength and soundness, the tests for the latter quality are much less generally known, and no kind of test is more frequently abused. Unsoundness generally arises from an excess of lime, which, for some reason or other, sometimes from the fact of the cement being too coarsely ground, has not had an opportunity of hydrating. Of the common tests for soundness, that based upon the measurement of the expansion is said to be unsatisfactory, while tests in which the cement is allowed to harden in a natural way in air take much too long, and hence so-called accelerated tests are adopted, in which a ball or pat of cement is exposed for some hours to steam, hot water, or boiling water. At the Philadelphia Testing Laboratory the balls of cement, after molding, are kept in moist air for 24 hours, and are then placed in cold water, which is gradually raised to the boiling-point and maintained there three hours. A series of experiments showed that a longer exposure to boiling water was uncalled for, since of a large number of balls which failed under a boiling test prolonged to 24 or 48 hours, 96 per cent failed in the first three hours, and 99 per cent in four hours. The boiling test is easily made, but its exact relation to the practical value of the cement is less easily established. In fact, while in many cases a cement which fails in the boiling test also fails in the work, in the vast majority of cases a cement which this test has proved to be unsound will prove quite satisfactory in practice. One reason for this is to be found in the fact that generally the cement is used much fresher from the kiln in the boiling test than it is in the work, and a few weeks' additional aeration often makes all the difference in the soundness of the cement. Further, the tendency of a cement to disintegrate is always greater when it is used neat than when mixed with an aggregate. On the other side of the question it has also to be recognized that it is possible to mix a cement so that it will stand the boiling test, but yet disintegrate if merely allowed to set in the open. More consistent results will, however, be obtained if the boiling tests follow the ordinary twenty-eight days' strength tests on which commonly the acceptance or rejection of a cement depends. No greater time is taken than if the boiling tests were made with the cement as first received, but the effect of postponing them till the strength tests are completed is to make them a much surer guide as to the probable soundness of the cement as actually used in the works under construction.

PORT TONNAGE OF THE WORLD.

The following table prepared in the Bureau of Statistics, Department of Commerce and Labor, shows the relative rank in tonnage movement of the principal ports of the world. Figures of coastwise trade are not included.

Port.	Year.	Entered. Tons.	Cleared. Tons.
London	1902	10,179,023	7,385,085
New York	1902	8,982,767	8,415,291
Antwerp	1902	8,373,528	8,347,483
Hamburg	1902	7,860,323	7,993,166
Hongkong*	1901	7,383,683	7,340,586
Liverpool	1902	6,843,200	6,314,514
Cardiff	1902	4,688,088	7,868,556
Rotterdam	1901	5,950,445	5,733,763
Singapore†	1901	5,459,032	5,453,999
Marseilles	1902	4,911,784	4,552,088
Tyne ports	1902	3,615,046	4,754,301
Gibraltar	1901	4,171,350	4,159,272

* Exclusive of Chinese junks engaged in the foreign trade. The tonnage of these vessels entered and cleared was 1,126,931 and 1,130,279, respectively, in 1901.

† Exclusive of warships, transports, native craft, and vessels under 50 tons, but inclusive of vessels engaged in trade between the Straits Settlements.

Correspondence.

SOME LIGHT ON THE HISTORY OF THE SUBMARINE TELEGRAPH.

To the Editor of SCIENTIFIC AMERICAN SUPPLEMENT:

To some of the great inventors who have, by their discoveries, illustrated the annals of science and conferred untold benefits upon the world, the crown of fame and profit has been duly awarded, while from others it has been ungratefully withheld. Notably among the latter is George B. Simpson, the original discoverer of the insulating properties of gutta percha, and of its successful application to the needs of submarine telegraphy.

Not one of the numerous accounts of the laying of the submarine cables in various parts of the world, including even the grand celebration in London, several years ago, upon which occasion Cyrus W. Field was justly honored as the energetic and successful projector of the Atlantic cable, uniting in instant communication Europe and America, mentions to the writer's knowledge, the name of the actual inventor of the means by which such results have become possible. Apparently the world so largely benefited by his arduous thought and labors knows not to whom its immense debt of gratitude is due. His claim is, however, a matter of executive, legislative, and judicial record; but the continuous obstacles thrown in his path in the proper acknowledgment of his great discovery have diverted the public mind from the true source of this not only national but international blessing.

The writer, being acquainted with every phase of this world-wide enterprise, feels that justice to the inventor demands a true history of the principal facts bearing upon the discovery of the submarine telegraph. Therefore he submits to an intelligent public the following summary:

George Badgly Simpson was born February 7, 1816, in Malta, Saratoga County, New York. He early displayed a strong liking for the study of the sciences, and his mind was continually employed in efforts to produce practical results from his acquired scientific knowledge. Soon after the first magnetic telegraph was put into operation between the cities of Washington and Baltimore by Prof. Samuel F. B. Morse and others, an obstacle was discovered which seemed to produce almost insuperable difficulties to its successful working. This was the lack of a perfectly insulated wire by which to conduct the electric current and maintain an unbroken communication through the waterways that impeded its course.

Various attempts and experiments were tried, with a view to securing this insulation. In 1845 Prof. Morse successively tried beeswax, asphaltum, and cotton yarn, all of which failed.

Ezra Cornell and Prof. Morse in 1846 tried wires across the Hudson, insulating one with asphalt and hemp, and another with glass beads, lead pipe, and asphalt. This attempt was also a failure. Downing's line, from Philadelphia to New York, tried India rubber unsuccessfully in the spring of 1848. The Magnetic Telegraph Company covered wires with asphaltum, and others with a lead pipe, inclosed in pump logs, in the fall of 1847 and early spring of 1848, but failed in both attempts.

All known insulators having thus failed to meet the necessary requirements, offers were made through the public press to anyone who would devise means whereby the difficulties which attended the use of an imperfectly insulated wire could be obviated. Acting upon these offers, in connection with the promptings of his own inventive genius, Mr. Simpson, then living in Cincinnati, Ohio, commenced a series of experiments which resulted in the development of the present invention, viz., the insulating or covering of the wire with gutta percha, which has proved to be the great desideratum in the successful operation of the magnetic telegraph system throughout the world and the one now in use by all telegraph companies.

Gutta percha seems to have been imported into England from the East Indies about 1845, and though it was used in Brooman's patent of 1845 as a mastic cement or fuel, and in Wharton's patent of 1846 as a substitute for leather, yet neither of these patents contains the slightest hint of the fact that gutta percha has any insulating properties or suggests its preparation in such a way that it can be relied upon as an insulator for wire. It was reserved for George B. Simpson to make this great discovery—a fact accomplished on November 22, 1847, and communicated to the friends of the telegraph enterprise at Washington on the following day. It is not necessary to follow the inventor through the annoying difficulties which the very men who made the offer permitted to gather about his path, for the telegraph company refused to come to his aid, and having no means of his own to bear the expense of obtaining letters patent to secure the fruits of his valuable discovery, he was left poor, neglected, and alone with his great invention—an invention which the public did not then appreciate, and as a consequence failed to extend to its author the timely arm of succor in his hour of sore need. The invention being once made, and the meritorious inventor left neglected and unassisted by those from whom he had reason to expect much, and to whom he had confided more, it was adapted and put into full practical operation by the telegraph companies without any recognition or regard for the unprotected interest or claim of Mr. Simpson.

However, notwithstanding the fact that his invention had been appropriated by others, he succeeded in filing an application for a patent on January 31, 1848, but which was not perfected until April 2, 1849. This application was rejected by the Patent Office on September 7 following, on the grounds that were afterward decided by the United States court to have been insufficient and erroneous.

Mr. Simpson then went West to the mines of Utah and Oregon, hoping to replenish his fortune and thus be able to renew the contest for his rights before the Patent Office. This became the one great idea and object of his life.

Several successive applications were made, and each rejected, upon the ground of abandonment, in consequence of the length of time intervening between the original and the renewed applications. Each successive commissioner of patents and board of examiners, however, hesitated not in declaring Mr. Simpson the original inventor, and agreed that the office should have granted his patent on his first application.

Unfortunately, under the law they were powerless to correct the error. Having exhausted all other means, and to avoid the technical objections raised in the office, Mr. Simpson appealed to Congress to remedy the wrong done him.

He asked a special act, by which the commissioner of patents might be authorized to hear the case upon its merits.

A bill to that effect was favorably reported unanimously by the House Committee on Patents; it passed the House of Representatives; was favorably reported by the Hon. Charles Sumner from the Committee of the Senate, and only failed in that body because being late in the session it was compelled to yield to the all-important appropriation bills.

The Committee on Patents of the House in the concluding paragraph of their report say: "That Mr. Simpson is the original inventor there is now no question. That he spent the best years of his life in the efforts made by him which resulted in the discovery, we are fully satisfied. There is not, and never has been any conflict of claim between him and any other person. His invention is highly useful and important, yet no patent has ever been granted therefor, either to him or any other person. Like the discovery of the other means of applying electricity to the use of man this, too, belongs to the science and genius of America. It is therefore but justice to the government itself, as well as to one of its worthy citizens, and to science, that this right should be secured to him and the record of this discovery be thus perpetuated among the archives of the nation. We therefore recommend the passage of the bill herewith reported for his relief."

But before any further action was taken in Congress the Patent Office finally decided to grant him the patent, so long withheld, and it was consequently issued to him on May 21, 1867, twenty years after his discovery was made—twenty years of toil, privation, expense, and suffering, during which large and rich corporations ruthlessly appropriated his invention and, pocketing the gains therefrom, gave him not one cent in remuneration.

Nor did his troubles end with the establishment of his rights by the committee reports of both Houses of Congress, and the assuring of his letters patent. So long had the great corporations enjoyed the fruits of his labors and so large was the amount due for their infringement of his rights, that they refused to recognize the validity of his claim and contested the government's decree. Thus it was destined that the sadly tried inventor was not to reap any material benefit from his great work, for having been appointed paymaster in the United States army and stationed at New Orleans, he contracted yellow fever and died on October 5, 1867, less than five months after the granting of his letters patent. In the long, cruel struggle to substantiate his claim he had exhausted his means and had been further obliged to assign to others two-thirds of his interest in his invention, and after his death his widow was forced to part with half of the remaining third, in order to be able to prosecute the infringement of the patent right in the courts.

A test case was made, and suit brought against the Western Union Telegraph Company before Justice Blatchford in the United States Circuit Court for the Southern District of New York in February, 1872, that company being the principal infringer. The defendant had all the sinews of war; it left no stone unturned, no fact unpresented; it scoured Europe to find evidence to antedate the Simpson invention or cast doubt upon it. Its vast revenues, its array of counsel and its corps of officers, authors, and electricians enabled it to command every avenue of information. The evidence taken in the trial covers 1,400 closely-printed pages, and seven years were consumed in the presentation of the case, and its decision by the court. Justice Blatchford, on November 26, 1878, in an able and exhaustive opinion, reviewing at length the law and the facts, decided that "on all the points at issue, it must be held that the plaintiff has established his case, and there must be the usual decree for the plaintiff for an injunction and an account with costs."

The legal title to the patent being vested in the assignee, another consequence of the original wrong, and he being exhausted both by ill health and the heavy expenses incurred in the prosecution of the suit, compromised with the Western Union Telegraph Company and other infringers for very inadequate amounts.

Thus neither the inventor nor his heirs received any but a compensation so meager that they were in nowise reimbursed for time, labor, or expense incurred in the long and obstinate contest, both before the office and in the courts.

And this for an achievement so splendid that by it all the nations of the earth are brought into a common bond of union.

"And one in heart as one in blood
Shall all her peoples be;
The hands of human brotherhood
Shall clasp beneath the sea."

The financial result might be borne with some degree of equanimity, were it not that the doubt and uncertainty attendant upon the long legal conflict as to the inventor's right has robbed him of that meed of recognition and praise so well deserved. To the general public he is apparently unknown, though the Western Union Company in its settlement with the assignee expressly acknowledges the originality of the invention, as well as the legality of the patent.

And still greater seems the injustice of this nonrecognition of the inventor's title when we recall the words of the board of examiners of the Patent Office on the last rejection of his application:

"Yes, sir; you lost your claim by default; you should have exhausted the resources of the law. You threw away millions of dollars. We sympathize with you very deeply, but we think the law adverse to your claim for a patent and have so decided. You are not only the first inventor of the submarine telegraph cable insulated with gutta percha, but you are the first to suggest the practicability of laying it across the Atlantic Ocean."

And this, coupled with the great probability that, but for the harassments of his telegraph application, he would have worked out the problem of the telephone earlier than it appeared; for, in a letter to Isaac M. Veitch, of the National Telegraph Company, of date January 12, 1854, he foreshadowed the coming of the telephone in these words:

"I have long entertained the opinion, however, that sound may be transmitted through a perfect tube with the same velocity as electricity to as great a distance, and with as much accuracy as ordinary conversation face to face."

So much for inference. But unalterably established is the fact that while science was groping in the dark, George B. Simpson told the telegraph world what to do, and by his genius the electric current is enabled to pass under broad rivers and fathomless seas, carrying instantaneous tidings from the remotest corners of the universe to the grand centers of commerce and of civilization. Had not this great discovery been made, Cyrus W. Field could not have accomplished the great feat of connecting the continents of Europe and America by submarine cables bearing messages of state, the requirements of trade, and the general wants of man.

The plaudits of two hemispheres were justly his.

It is but justice, also, to a worthy citizen, to science, and to the genius of America, that the name of George B. Simpson should be identified with his noble discovery and enrolled among the benefactors of mankind.

EXTRACTS FROM BALTIMORE PAPERS DESCRIBING SIMPSON'S EXHIBITION OF HIS INVENTION AT THE MECHANICS' FAIR.

[Extract from Baltimore Sun, November 20, 1848.]

"Submarine Telegraph.—Mr. George B. Simpson, who is now in attendance at the fair at Washington Hall, has shown us a plan for a submarine telegraph, of which he is the inventor, and for which an application for a patent has been made.

"The design is to form some mode by which electricity may be conveyed under the water, or in the earth, without the current being broken.

"The inventor proposes to effect the object by insulating the metallic wire by covering it with a glass pad chain socketed and closely jointed together. The glass chain is to be covered with an insoluble India-rubber or gutta-percha tube, jointed, cemented, and branded together, so as to form a perfect conductor of electricity.

"The project has met with quite a favorable consideration from gentlemen connected with telegraphic operations, who express their conviction of its feasibility. If successful—and we see but little objection to it—it will be a most important invention, the results of which in conveying intelligence can scarcely be estimated."

[From the Baltimore Clipper, November 23, 1848.]

"Valuable Invention.—We were shown yesterday the model of a submarine electro-magnetic telegraph wire, which has just been invented by Mr. George B. Simpson, of Cincinnati, Ohio, and which we think promises to be invaluable as means of sending a perfect and unbroken line of telegraphic communication.

"All along, as our readers are aware, the difficulty of passing rivers has proved a great barrier to the perfecting of the various lines of magnetic telegraph with which the several sections of our widespread country are at present connected. And various have been the experiments tried to discover a mode of conducting the mysterious agent across rivers. This difficulty, we think, is effectually remedied in the present invention. The principle of the invention is as follows: The wire, after being insulated with insoluble India rubber or gutta percha, is covered with glass beads socketed together in such a manner as to give about 1-16 of an inch play in every two inches of wire. A tube made of insoluble India rubber or gutta percha is then passed over all, the beads being held in their places by the outside tube, which is pressed into grooves made in the beads. This done and the wire is complete and ready for use.

"Should it be desired, rings made of gutta percha and filled with air are attached to the wire, by which means it can be made to lie on the surface of the water or be sunk to any depth that may be required. The plan has been examined by a number of scientific gentlemen and by all judged most valuable as an infallible means of securing the first object aimed at by the inventor. We understand that steps are about being taken to introduce it on several of the telegraphic lines now in operation."

New York city. BAKER A. JAMISON.

SOME NEW AUTOMOBILE ACCUMULATORS.

MUCH interest is being manifested at the present time in the question of accumulator cells for automobile work. The tire difficulty, which previously gave so much trouble, has apparently been overcome, and in the matter of motors and controllers the new electrical vehicles are practically perfect. It only requires a thoroughly satisfactory cell to place the electric automobile in front of every other for general convenience, ease, and quietness of running, and possibly also durability and cost of unkeep.

The great desideratum of an automobile cell is a high charge rate, so that when making long journeys the car can run to any electrical station and have the battery completely charged in, say, three-quarters of an hour. The ideal thing would be to drop half a crown in a slot and get juice forced into the cells while the driver is having a drink, but possibly this is asking too much at present; it will, no doubt, come to something like that in time.

Practically all cells at present on the market have the objection that the plates buckle under a quick charge or discharge. Let us consider for a moment what are the mechanical reasons for a plate buckling. All plates so far have consisted of a rectangular lead, grid, or plate, or else a rectangular frame, as in the D. P. cell, with strips of sheet lead laid across. Now, during charging, expansion of the active material takes place, and if the charge is too rapid, such expansion is proportionately great. As the actual lead plate or frame does not expand so quickly as the active material, there is nothing for the latter to do but to bend outward, or, in other words, buckle. By a proper recognition of the simplest laws of mechanics it should be possible to design a plate in which the active material may expand and contract quite freely.

Yet, for some reason or other this has not been done. The situation, in fact, reminds the writer of the time when the diamond frame safety bicycle was introduced, and those associated with its manufacture had not the engineering gumption to employ a cross bar, and so change a redundant frame into two rigid triangles. A few minutes' study of a five-barred gate would have shown the reason why. Accumulator manufacture appears to have been through much the same stage; for the designers have been so busy with chemical equations and methods of making lead porous, etc., that they omitted to look at the plate itself simply as a problem in mechanical design. The men in accumulator work, as in so many other branches of electrical activity, have, in fact, been too much the electricians and too little the engineers.

The writer has had an opportunity recently of investigating two forms of cell which are about to be put on the market in which this buckling trouble is done away with. The first is the Elieson plate cell, and the second a solidly built cell designed by Mr. Niblett. The Elieson plate is on the lines of the D. P., but the strips of lead are alternately straight and crimped. They are united together by a central core of lead, from each side of which the strips extend like the hairs from a feather. At the top and bottom cross pieces of wood give support to the ribs or vanes. As the strips are only held at one end, the oxidized material is absolutely free to expand and contract, and consequently buckling is obviated.

An Elieson cell containing three negatives and two positives, measuring 8 by $5\frac{1}{2}$ by $\frac{3}{4}$ inches, and weighing $22\frac{1}{2}$ pounds, complete with acid, is rated at 115 hours' capacity on a five hours' discharge rate. Such a cell was tested at the Reading Electricity Works, with the following results: The cell being nearly fully charged was discharged at the rate of 20 amperes down to a voltage (on load) of 1.50 volts. It was then completely charged in 75 minutes, commencing at a rate of about 120 amperes and finishing at a rate of about 45 amperes, the total charge being 110.69 ampere hours. It was again discharged at the twenty ampere rate, and continued until the voltage dropped to 1.5, the total discharge capacity being in this case 101.66 ampere hours, thus showing an ampere hour efficiency of approximately 92 per cent, which, considering the high rate of charge, is remarkably good. The discharge was then continued at the twenty-ampere rate until only 0.50 volt was registered, and the cell was then short circuited and left for forty-eight hours. A charge of 128 ampere hours was again made in one hour, the rate for about 20 minutes being nearly 150 amperes. An extra 40 ampere hour charge was then made in one hour, and the cell left for four days. At the end of this time a discharge made at the high rate of 50 amperes for one and a half hours, and for a further forty-five minutes at lower rates, showed a capacity of 106 ampere hours, clearly demonstrating that no loss of capacity had been caused by the severe ill usage to which it had been subjected, the overcharge having been sufficient to reduce all the sulphat-

ing caused by the overdischarge and to restore the cell to its normal condition.

The new Niblett cell mainly consists of a lead-lined box, the lining forming one pole, a porous pot containing and being surrounded by active material, and a central solid rod of lead for the other pole. The distance between the rod and inside of the porous pot is about one inch, while the space outside the porous pot to the lead lining varies from one inch at the shortest point to two inches at the corners, due to the pot being round and the containing box square.

The active material consists of alternate layers, each about one inch thick, consisting of pieces of lead rendered flaky by being melted and dropped into water, and of pellets of litharge about three-sixteenths of an inch in diameter. These are pressed down fairly tight, first a layer of lead and then one of litharge, until the whole space, both inside and outside the porous pot, is quite full. The acid finds its way into the small spaces left between the pieces of lead and of the litharge, and expansion is taken care of by these spaces. There is, of course, no question of any buckling in such a cell, but, unfortunately, weight is against it, while the porous pot increases the internal resistance, and is, of course, liable to get cracked. At the same time this seems to be the only feasible way of making a pasted cell without having the buckling trouble.

The Crowdus plate is a pasted one, and has given some good results, yet the writer considers that paste is not really feasible for automobile work unless the material is packed in solid as in the Niblett cell. If the plate is employed at all, it seems to the writer that it must be of the Plante type, and judging by the results obtained by Mr. Elieson, a Plante cell can be made to compete with the highest form of pasted plate cell in the direction of capacity in watt-hours per pound of weight.—E. Kilburn Scott, in the London Electrical Engineer.

CONTEMPORARY ELECTRICAL SCIENCE.*

OSCILLATING POINT DISCHARGE.—K. Przibram has examined the influence of pressure upon the point discharge as studied by Himstedt, Pflüger, Möhlmann and Von Wesendonk. He confirms the latter's observation that the positive discharge is the more powerful only when the discharge is disruptive, whereas a continuous point discharge produces more negative electrification of the air. An important result obtained is that the region within which positive electrification is in excess contracts as the pressure is reduced. This squares with the fact that a reduction of pressure encourages the continuous discharge. Possibly there may also be a contraction of the whole space covered by the Himstedt effect.—K. Przibram, Phys. Zeitschr., August 1, 1903.

CONDUCTIVITY OF DIELECTRICS UNDER RADIUM RAYS.—A. Becker has succeeded in proving that a number of insulators such as shellac, paraffin, mica, and ebonite acquire a small conductivity when exposed to radium rays. The conductivity acquired by gases is well known, and Curie has shown that insulating liquids also acquire such a conductivity. But the difference in the case of gases is that there exists a saturation current, due no doubt to the complete ionization of the gas. Such saturation current does not exist in either solids or liquids, or has, at all events, not yet been reached. To test the conductivity of solid dielectrics, the author inclosed a layer of the dielectric between the plates of a condenser made of heavy plates of lead. A small chamber was hollowed out between the plates, and a radium preparation placed inside. To avoid the direct influence of ionized air upon the dielectric, the latter was covered with aluminium foil. On applying an E.M.F. of 500 volts, it was found that there was a leakage of about 0.0006 volt per second through a sheet of shellac 1.5 millimeter thick. The current was about 66×10^{-15} amperes. Reversal of the current made no difference. The maximum current was only reached slowly, which means that the ions formed have some difficulty in following the electric force. The general process resembles that observed in liquid dielectrics.—A. Becker, Ann. der Physik, No. 9, 1903.

THIRD SPECIES OF RADIUM RAYS.—R. J. Strutt has specially examined the so-called γ-rays or intensely penetrating radium rays, which have hitherto been supposed to be identical with Röntgen rays. He finds that they agree with the latter in not carrying an electric charge, in photographic and screen effects, and in ionizing power, but that they differ as regards their ionizing effects on various gases. This difference is so pronounced that the author feels justified in denying their identity with Röntgen rays. Taking the ionization of air as unity for the three species of radium rays and for Röntgen rays, the ionization of, say, carbon tetrachloride comes out as 5.34, 5.83 and 5.67 for the α, β and γ rays respectively, but 45.3 for the Röntgen rays. In methyl iodide the difference is even more pronounced. The radium rays of all kinds obey a different law from the Röntgen rays, and are probably all of a corpuscular nature. The supposition that the β or cathode rays produce γ or Röntgen rays by impact upon the radium itself is unlikely for quantitative reasons, since the current emitted in cathode rays by a square inch of intensely active radium is only 10^{-11} amperes, whereas the current through a focus tube is of the order 10^{-3} amperes.—Hon. R. J. Strutt, Proc. Roy. Soc., August 15, 1903.

* Compiled by E. E. Fournier d'Albe in the Electrician.

ELECTRICAL POWER IN WEST AFRICA.

THE use of electrical power in gold mining is a comparatively new application, and up to the present but few such installations have been put into operation. The one notable instance of employing electricity for this purpose is, of course, at the Kolar goldfields, in the Mysore State of India, where the electric power is transmitted over a distance of 92 miles from the Cauvery Falls. A scheme which promises to be the parallel of this one both in importance and scope is now projected for the West Coast of Africa, better known as the Gold Coast. In the absence of coal or other suitable fuel it is recognized that if electric power is to be utilized, it must be generated by water power. It is therefore proposed to harness the River Tano, the second largest and longest river on the Gold Coast. The electric power produced would be used for hauling, pumping, and crushing, as well as for operating light railways. Some particulars of the scheme appear in our contemporary West Africa. The Tano River, we are told, possesses a fall of over 75 feet within a distance of one mile, the largest fall being considerably over 40 feet in a distance of 100 yards, and competent mining engineers are convinced that what is practicable in India is practicable in West Africa. There is, of course, the question of the distance of transmission, but it is not thought likely to prove an obstacle to the adoption of the present scheme. From the Cauvery Falls to the Kolar mines is over 92 miles, whereas the approximate distance from the Tano to the Tarkwa center does not exceed 40 miles. At any rate it will be safe to place the total distance, including distributing lines, at about 60 miles, which in time could easily exceed 150 miles, sufficient to tap any of the colony's goldfields. The cost of a 5,000-horsepower transmission plant is roughly estimated at $700,000, the capital required for its erection at between $100 and $150 per effective horse power, and the operating expenses, taking into consideration the local conditions, at $142,500. The output of such a plant operating on a mixed load 24 hours per diem for 300 days per annum would be, say, 21,480,000 kilowatt-hours per annum, which brings the net cost to less than 4 cents per horse power per hour. The writer says the cost of horse power per annum of steam power generated by coal and wood fuel would in West Africa exceed $200. Therefore, in placing the average price of an electrical horse power per annum at $125 for 5,000 horse power, the gross income would be $625,000, less working costs $150,000—total, $475,000 profit, or 25 per cent on $1,500,000 nominal capital, with 6 per cent per annum for the amortization, which would allow the capital being paid off in fifteen years. Over two dozen mines, it is said, are at least rapidly approaching to a stage when the necessity for a cheap power will become inevitable, and it is contended that if twenty-odd companies are the only consumers available under the outlines of the scheme, they will benefit to an extent proportionately higher than the eleven Kolar mines, which are expected to save well over $250,000 in working expenses during the existence of their ten years' contract. We gather from the article that a syndicate has been formed to develop the Tano River scheme.

THE WALLS OF ANCIENT TROY.

TROY! The very name conjures up visions of the "Iliad" and the "Odyssey." There was much speculation as to the probable historic value of these literary productions, but Dr. Schliemann, merchant and born archæologist, solved for all time the doubts of scholars. On the hills of Hissarlik Dr. Schliemann uncovered the ancient palaces of Troy, laid bare its colossal fortifications, and brought to light its treasures of gold and silver. Our knowledge of the "Ilios" of the Trojan war is solely derived from the Homeric poems. The Greeks themselves knew nothing beyond what these wonderful poems tell us. According to Homer, Troy is a wealthy capital situated in the neighborhood of the Hellespont and facing the little Island of Tenedos. So wonderful were the towers and walls of the citadel, that the ancients ascribed their building to Poseidon and Apollo.

On the site of Troy Dr. Schliemann found seven superimposed cities. The first lies on the virgin rock. On its ruins a new level was formed at an increased altitude of 11 to 20 feet. On it are the buildings belonging to the second settlement, the golden era of the citadel, and these seem to have been constructed with clay bricks. The golden era seems to have been of short duration. The city finally came to an end in a great conflagration. The most imposing erection of the new or second period is the great citadel wall, which is still in good condition. Along the preserved portion the line of the wall is double. The circuit walls consist of a stone superstructure, scarped on the outside at an angle of 45 degrees with a vertical face to the inside. The top surface is 13 feet wide, and keeps a uniform level, while the depth varies according to the exigencies of the soil. To the east it is only 3 to 5 feet thick, everywhere else more. The core of the wall consists of small quarry stones bonded with clay; the outer scarp is revetted with big stones as much as 18 inches long by 10 inches high. On this superstructure was erected a vertical wall of clay bricks 11 feet to 13 feet in thickness. In order to

RUINS OF THE WALLS OF ANCIENT TROY.

secure the solidity of the wall several strong beams measuring one foot square were laid along it. The only traces left were the holes in which they were fixed. The question of subsequent walls is admirably discussed in Schuchhardt's Schliemann.

COLLIERY EXPLOSION RESCUE WORK—SOME INTERESTING EXPERIMENTS.

Some interesting experiments have been carried out at the Wharncliffe Silkstone Colliery, Tankersley, in Yorkshire, in connection with colliery explosion and rescue work. This innovation has been introduced for the purpose of minimizing the effects of explosions and the terrible after-damp.

At this colliery the men have been trained in the use of a special artificial breathing apparatus, which will enable them to penetrate into workings and bring their stricken comrades out of the pit in case of an explosion, despite the presence of after-damp. The apparatus employed is the Giersberg pneumatophor, and is a combination of the inventions of Dr. Giersberg and Chevalier von Walcher. It comprises essentially a breathing bag, to act as an artificial lung. It is filled with a quantity of solid alkali, the function of which is to absorb the carbonic acid gas breathed out of the lungs. Oxygen is supplied to the miner wearing the apparatus in a rescue party exploring in the midst of after-damp from a pair of small steel cylinders, carried on the back at a pressure of 120 atmospheres per square inch. The flow of the oxygen is regulated by a special valve, which allows two liters per minute to pass into the breathing bag. In the earlier forms of the pneumatophor, the supply of oxygen was adjustable by the wearer of the apparatus, but now the appliance is fitted with an equilibrium valve, rendering the supply automatic and constant and requiring no attention whatever on the part of the wearer.

In the practical test carried out at this pit, an abandoned roadway which had partly fallen in, and representing fairly well the state in which a mine is usually found after a disaster, was made use of.

A number of men participated in the demonstration, which consisted of carrying a man on a stretcher a distance of about 100 yards, and traveling a distance of a quarter of a mile without any burden, the only means of respiration being the above apparatus. The first experiment was successful. The men performed the distance stated without showing any signs of difficulty of breathing, and expressed themselves confident of being able to perform double the journey with ease.

From the result of this experiment, which was carried out before one of the government inspectors of mines, it is anticipated that the number of fatalities attending colliery explosions will be considerably reduced.

A NOVEL METHOD OF TRANSPORTING PHOTOGRAPHIC NEGATIVES.

The latest methods of photographic manipulation are so well adapted to the needs of the modern newspaper in supplying quick and accurate illustrations of current events, that a plan somewhat akin to wireless telegraphy in the novelty of its carrying out was accomplished in the summer of 1903 by an enterprising journal in Newark, N. J., about the international yacht races. To know at 11:04 that the "Reliance" crossed the line at 11:00:36 and the "Shamrock" at 11:02:00 is no more prompt service than one expects. If it were slower, the business man would chafe at the delay. But, accustomed as he is to rapid service in the transmission of news, he wonders where the annihilation of time and space is to cease when in his afternoon paper he sees a half-tone reproduction of that start, even before the great yachts have shot across the finish line.

But this feat has been accomplished, and in a most novel way, thanks to modern photography and a carrier pigeon. On the morning of August 25, the second day of the races, Edwin G. Koenig, a clever amateur photographer of Newark, was sent as special representative of the Newark Evening News aboard the revenue cutter "Gresham" to photograph the race off the Highlands of New Jersey, thirty miles from Newark. Mr. Koenig took with him a kodak, a kodak developing machine, the material necessary for developing film negatives, and a number of carrier pigeons owned by H. J. Maynard, of No. 172 Johnson Avenue, Newark. Aboard the "Gresham" Mr. Koenig was able to secure excellent positions for photographing, and as the yachts crossed the starting line at 11:00 o'clock, he "snapped" them. Immediately after taking the picture he arranged his developing machine upon a table on the deck of the revenue cutter in view of the interested spectators, and in broad daylight developed his roll of film. Within ten minutes the negative was complete. Meanwhile, assistants had one of the carrier pigeons in readiness, and the negative, hurriedly dried, was rolled tightly into as small a compass as possible and securely wired to the bird beneath the tail, where it would in no way impede its

THE YACHT RACERS AS REPRODUCED FROM THE CARRIER PIGEON NEGATIVE.

flight. The pigeon was then released. Circling about the steamer for a few moments to get its bearings, in the dense mist which on that day overhung the ocean, it turned toward Newark and sped away on its long flight. The pigeon reached the loft at its owner's home on Johnson Avenue in exactly one hour and a half. Upon the bird's arrival the waiting newspaper men found Mr. Koenig's negative in excellent condition, although the tiny roll was so concealed by the feathers that at first it was thought to be lost. As soon as the negative was secured it was rushed to the newspaper office, where men were immediately set to work making a print from it and performing the various operations incident to preparing the half-tone plate. At exactly 3:45 o'clock the stereotyped plate containing the photograph was placed on the press, and a few minutes later a picture of the yacht races of the morning was being scanned by eager readers.

Mr. Koenig took photographs of the race at different times during its progress and dispatched several negatives, developed on the steamer deck, to his newspaper by carrier pigeons. These all arrived safely, in spite of the fact that during the entire day a thick haze hung over the ocean.

The accompanying illustrations show the journalist operating the developing machine, attaching the developed film to the tail of the carrier pigeon, the release of the pigeon, and the picture of the yachts as reproduced from the negative.

ATTACHING THE DEVELOPED FILM NEGATIVE TO THE CARRIER PIGEON.

RELEASING THE CARRIER PIGEON.

DEVELOPING THE FILM IN DAYLIGHT WITH A KODAK DEVELOPING MACHINE.

ON A PRINCIPAL CAUSE OF THE SALTNESS OF THE DEAD SEA.*

By William Ackroyd, F.I.C., F.C.S., etc., Public Analyst for Halifax.

The saltness of the Dead Sea has been ascribed to two causes: (1) The accumulation of chlorides derived from the rocks of the Holy Land by solvent denudation, and (2) the cutting off of an arm of the Red Sea by the rising of Palestine in past ages, with, in each case, the subsequent concentration of the solution by evaporation (Hull, The Phys. Geol. of Arabia Petræa and Palestine, pp. 119 and 120). There is a third cause, which is probably more important than either, viz., the atmospheric transportation of salt from the Mediterranean. The circulation of salt is a reality which must be taken into account. Brought from the sea by winds and falling in the rain, the salt is carried back to the sea by rivers, except in cases of inland lakes without outlet, where the saline solution remains for evaporation, and I have shown that in the case of an inland Pennine reservoir such a cause would produce a water as salt as that of the Dead Sea in a fraction of the time usually assigned to the Pleistocene Age (Geol. Mag., October, 1901, p. 446; also compare J. G. Goodchild, Trans. Geol. Soc. of Glasgow, 1898, vol. xi., Part I., p. 84).

For the purpose of the present paper analyses of rain water from the Holy Land are wanting; as, however, they are not at present available, I assume that the rain, like that of other lands, is charged with salt to a degree which varies in a direct manner with the velocity of the winds coming from the sea; it then only remains to show that the rocks are not abnormally salt bearing (Proceedings of the Yorks. Geol. and Polytechnic Soc., vol. xiv., Part III., pp. 403-408).

I have had forwarded to me by the Palestine Exploration Fund specimens of the rocks on which Jerusalem is built as samples of Palestine rocks. They are limestones of various compositions, and the amount of common salt, calculated from the chlorine I have found in them, is given in the following table:

Description of limestone.	Per cent of chlorine.	Calculated per cent of common salt.
1. Kakule	0.025	0.041
2. Nahre	0.001	0.002
3. Meleke	0.006	0.010
4. Misse (yehudi)	0.005	0.008
5. Misse (helu)	0.0015	0.002
6. Misse (achmar)	0.001	0.002
Average	—	0.01

The salt contained in these rocks, except in the case of Kakule limestone, is no greater in amount than that found in the limestones of other lands which similarly approximate to a general average of 0.01 per cent of chlorine. This amount of chlorine would be quite inadequate to account for the salt in the Dead Sea. By a technical argument based on the amount of chlorine in a rock and its rate of denudation, I have shown that the salt yielded to rivers from this source is not a ninety-ninth of that which has been supplied by rain-water (Chemical News, vol. lxxxiii., p. 301, and Geol. Mag., October, 1901, p. 447). Nor would the saltness of the Dead Sea be fully accounted for if a marine area had been cut off during the rising of the land, as the initial saltness thus acquired would only be about a fourth of that subsequently attained to, and moreover in this condition of saturation it has been for an unknown length of time continuously precipitating its excess of salt. Hull observes (op. cit., p. 120): "The increase of saltness in the waters of the Dead Sea has probably been very slow, and dates back from its earliest condition when its waters stretched for a distance of about 200 miles from north to south. While the uprising of the land and the sinking down of the Jordan Arabah depression were in progress during the Myocene period, some of the waters of the outer ocean, themselves salt, were probably inclosed and retarded; but from the occurrence of the shells in the marls in the Arabah Valley, it would appear that when the waters of the great inland lake were at their maximum elevation, they were sufficiently fresh to allow of the presence of molluscous life. This would be during the Pluvial epoch, but at the stage represented by the salt beds of Jebel Usdum, the waters, which were then 600 feet higher than at present, must have been saturated with chloride of sodium." One may add that the intensity of meteorological conditions in the past geological history of Palestine has been much more severe than those now obtaining, and the atmospheric transportation of salt would be correspondingly greater (Tristram, "The Land of Israel," p. 320). Some of the salt then accumulated has been left by the dwindling waters of the Dead Sea in areas to the north and south, notably in Jebel Usdum, and the highly brackish rivulets which come from these neighborhoods now are but contributing again what long ago came from more distant sources.

I find confirmation of the theory in the fact that the ratio of the chlorine to the bromide in the waters of the Dead Sea is approximately the same as that for these two elements in the Mediterranean Sea (Proceedings of the Yorks. Geol. and Polytechnic Soc., 1902, vol. xiv., Part III., p. 408).

In conclusion I have to offer my best thanks to Mr.

* From the Quarterly Statement of the Palestine Exploration Fund.

Walter Morrison, J. P., of Malham, and Mr. George Armstrong for the privilege of having been enabled to examine the rocks from Palestine which are mentioned in this paper.

SOME SPECULATIONS ON THE NATURE OF COMETS.

WE can only study the universe by sample. The "visible universe" is a sample of the whole universe; and the study of the phenomena of the former reveals to the student the laws governing all like phenomena under like conditions. Thus we reason from the known to the unknown.

Any one who has witnessed the experiment of admitting a ray of light into a dark room through a small aperture, has noticed the "motes in the sunbeam." If the ray be successively reflected to all parts of the dark room, the "motes," or particles of dust, will be seen wherever the ray may be, no matter how rapidly the ray may be made to move about. This does not show that the dust particles are moved from one part of the room to another, but simply that dust particles exist in all parts of the room, and that the ray simply lights them up and makes them visible. The dust was not seen until lighted up.

The interstellar spaces contain much dust. We do not ordinarily see it, because these spaces are dark, and the dust is not lighted up. But when a mass of this cosmic dust, in its movement through space, approaches the sun, and has somewhere within the mass a nucleus capable of transforming the energy emanating from the sun into light, and of transmitting it as a ray, a "comet" is "developed." The nucleus becomes luminous and the ray, lighting up a portion of the dust mass following, becomes the "tail" of a comet. The nucleus and tail both appear brighter, and the tail longer, as the dust mass approaches the sun. As the dust mass in its orbit passes around the sun, the head of the comet appears to present the same side to the sun, while the tail flashes around, streaming away from the sun; and as the comet moves away from the sun, the tail precedes it.

Keeping in mind the action of the light ray upon the dust in the dark room, we may infer that the ray from the nucleus of the dust mass, as the mass passes around the sun, simply lights up different portions of the mass, and thus produces the appearance of the tail flashing around the sun with incredible swiftness. The same explanation applies to the appearance of the tail following the nucleus as the comet nears the sun and preceding the nucleus as the comet moves away from the sun. The length of the tail shows approximately the extent of the mass in the direction in which the tail points, and the mass must therefore be approximately circular. The known laws of attraction of matter indicate that the dust mass must be spheroidal in shape.

When such a dust mass, in its orbit, passes near the sun or a planet, many of its particles must be attracted away by these larger bodies, and so the dust mass must be diminished, and the mass of the larger bodies correspondingly increased. Some of the particles become meteors, and some may be large enough to become asteroids, or even moons. On the other hand, the large dust mass, in its orbit, must meet and absorb much cosmic dust, and thus may practically retain its size and weight, during many passages through its orbit, or it may be, on the whole, increased or diminished by these means.

When a comet is "lost," as in the case of Biela's comet, it may not have changed its form or its mass. It may still be spheroidal in shape, but the nucleus may have disintegrated or in some way have lost the power to transform and transmit the sun energy as a ray of light. In consequence, the dust mass becomes wholly invisible in the dark room of space. If such a dust mass comes within the influence of the earth, meteors may appear at the time when the comet should have made its appearance had it not been lost.

Thus the study of the action of light upon dust in a small dark room may explain the phenomena shown by comets in the large dark room of space.

There can be no "gas" or "fire mist" in the interstellar spaces, as they are absolutely cold, as well as dark, and we now know that the lightest known gas becomes solid long before it reaches the temperature of space. Hence all matter floating about in interstellar space must be solid.

World formation and destruction are going on now, before our eyes, just as they always have been and doubtless always will be going on. There are no new laws or methods, or "dead" laws or methods, in the universe. There never was vast space, as of the solar system, filled with "fire mist," gradually cooling to form suns and worlds. They were built, and are continually being built, of cold cosmic dust. It can be said of them, as has been said of the human body, "Dust thou art and unto dust shalt thou return."

In regard to comets, explanation is still required as to the constitution of the nucleus, and how it transforms and transmits the sun's energy. This involves the question as to the nature of the sun's energy, how produced, transmitted, and transformed, and so of the constitution of the sun itself.

Nevada's State mineral exhibit, which has an approximate value of $70,000, will be exhibited at the World's Fair at St. Louis. In addition there will be a number of valuable private cabinets shown.

ELECTRICAL NOTES.

An installation of wireless telegraphy, which will undoubtedly prove of the greatest value in the future, is about to be made in connection with the lightships off the southeast coast of England. The Goodwin Sands, though chiefly instrumental in forming the historic roadstead known as the Downs, are in themselves a considerable danger to passing vessels, especially in foggy weather; and there are at least four lightships stationed at different places over the sands to warn vessels which are not keeping their course. These lightships are about to be equipped with wireless telegraph apparatus, which will place them in easy communication with the Admiralty wireless telegraphy station near the Shakspere Cliff at Dover. In cases of disaster the apparatus should prove of the greatest value and importance in obtaining help.

The Resident General for the Federated Malay States, in his report for 1902, states, as regards the planting interest, that further experience confirms the belief, or rather indorses the certainty, that the combination of climate and soil in those states pre-eminently adapts them for the cultivation of rubber (Para and Ramsong), the demand for which is annually increasing. He adds: "Export of Para rubber in quantity has not yet commenced, and we may have to wait a year or two longer for that consummation, but meanwhile we know that our samples realize high prices in England, and that additional outside capital is coming in to extend the area of land under this cultivation." The area under rubber cultivation at the end of 1902 is given approximately at 16,000 acres. It seems that the disinclination which exists to extend the cultivation of rubber in the Malay States is due, not to lack of faith in the future of this cultivation, but to want of capital.

In many modern mines electricity is used for signaling on engine planes and in shaft hoisting. It is also used therein for speaking purposes, as in the telephone, and in mines where safety lamps are used it is considered the best means of firing shots. Electricity is also largely employed to do the heavier work of lighting, hauling, pumping, machine coal cutting, rock drilling, hoisting, and driving ventilating apparatus. Electricity for speaking or signaling purposes needs the use of only a feeble current, usually produced by chemical action set up by causing the liquid chloride of ammonium to act upon two distinct metallic substances, usually copper and zinc, in connection with each other by a suitable wire circuit, or by substituting carbon for copper, which is done in the Leclanché cell, commonly used for this purpose in mines, the extent through which the electric energy may be felt depending upon the length of the connecting circuit. Shot firing is usually done by means of a small magneto electric battery, or miniature dynamo, in which case the feeble currents from the electrically excited magnets pass along the cable to the highly sensitive detonating material inclosed in the copper tube, called the detonator. Sufficient resistance is set up in the detonating material to cause a spark to pass in the high tension arrangement, or to heat a very fine strip of platinum in the low tension, either of which is sufficient to detonate the matter and explode the charge.

The problem of using wind power in connection with electricity works has often been investigated, the principal drawback being the variable strength of the wind, resulting in corresponding variations in the speed of the dynamo. This difficulty, however, has, it appears, recently been solved by Prof. La Cour, who, on behalf of the Danish government, has for some years past been engaged in studying the question. In order to impart to the motor an approximately continuous speed independently of the strength of the wind, Prof. La Cour, as pointed out in a lecture delivered before the recent Copenhagen Technical and Sanitary Congress, uses an intermediate shaft placed in connection with a balance. The belt from the mill runs vertically to the pulley on this shaft, its pressure on the pulley being regulated by the balance bearing convenient counter-weights. This arrangement results in the belt sliding on the disk as soon as the load exceeds a given maximum. A plant of this kind, feeding about 450 incandescent lamps, has for nearly a year been in operation at Askov, Denmark, petroleum motors serving as a reserve in case of several days' calm. The constant normal current with this works is 50 amperes, and the distribution tension is 110 volts. This plant has so far worked with satisfactory results, and required no supervision worth speaking of. As regards the economical side of the question, a similar plant has been found to pay very well, the first cost being about $4,320, out of which $810 correspond to the petroleum motor. The current is supplied to consumers at the same price as in Copenhagen, i. e., at the rate of 13½ cents per kilowatt hour for lighting and 4½ cents for power purposes. The receipts for energy sold have been about $756, and the expenses about $216 per year. There thus remain $540 profit, a sum more than sufficient for a capital of $4,320. The price of the energy could, therefore, be further diminished. In the case of very small electricity works intended for the use of a limited number of houses, the petroleum motor may advantageously be replaced by a horse-driven contrivance. Moreover, in the case of the proprietor of the works being his own consumer, **the consumption of current may be regulated according to the actual supply of wind, the cost of the plant thus being further diminished**

ENGINEERING NOTES.

The portions of the Prussian State Railroads where there is danger of setting fire to woods or heather are to be designated by painting the telegraph poles white for about a yard on a level with the engineman's eye.

Of the 37 war vessels belonging to the British navy which have been subjected to speed tests during the past year, 28 attained speeds in excess of 21 knots, and of these 12 were cruisers, the remainder being torpedo boat destroyers and torpedo boats. Of the number, too, seven were armored ships of about 23 knots. The significance of these figures is reflected by the fact that prior to 1895 no ships other than torpedo craft in the British navy had a speed exceeding 21 knots, with the exception of the "Blake" and "Blenheim," whose designed speed of 22 knots could not be relied upon, owing to boiler difficulties.

The bane of railroad operation is the empty car haul, and to its reduction the best efforts of the transportation department are being constantly put forth. It is realized that the movement cost of each ton is the same whether it is embodied in the car itself or in its contents, and when it is considered that from 30 to 40 per cent of the total tonnage moved by railroads consist of empty car haul, the importance of the question is easily understood. In view, therefore, of the magnitude of the subject and the part that it plays in operating expenses, it seems a little strange that a car of general utility, that is to say, one which could be used for two or more special commodities, has not yet been evolved. A number of attempts have been made to provide a car which would answer for both live stock and merchandise, but that appears to be impossible in the nature of things. A car suitable for joint use in coal and live stock traffic, or in coal and merchandise traffic, would seem to be more nearly possible, and we understand efforts are now being made in both of these directions. There is certainly enough to be gained by the production of a successful car of this character to warrant the devotion of the time and energy for its production.—Railway Age.

A wire-rope tramway now under construction in Argentina, claims attention both on account of its length and the great difference in altitude between the terminals. It is to be used for the transport of ores from the mining district of Mexicana, in the Andean Cordilleras, to the station of Chilecito, on the North Argentina Railroad. With a length of 35 kilometers (22 miles), it reaches an extreme altitude of 14,000 feet above sea-level, making a rise of about 11,500 feet in the distance mentioned. The country traversed is extremely broken, which necessitates, in places, very long spans between towers, as well as unusual elevations of the cable. The longest span is 2,765 feet, and in crossing one valley the cable swings 625 feet above the ground. As the entire installation, including cables, towers, boilers and engines, has to be transported from the nearest railroad station by pack-animals, the heavier parts are made in sections of convenient weight for handling. The total length of cables is 140 kilometers, and the weight of the entire outfit, including some 16,000 parts, is approximately 2,000 metric tons. The tramway is designed to carry 40 tons of ore per hour, with a speed of 2.5 meters per second, the cars being of 500 kilogramme capacity. Its construction is now well under way, and the first section will soon be in operation. It is built upon the Bleichert system.

An adjustable steel false work for erecting short railroad bridges has been considerably used in India and was recently illustrated in Indian Engineering. It virtually consists of towers made with two transverse bents of three vertical posts each. The vertical posts are in 6, 9, and 12-foot lengths of 5-inch pipes put together with butt joints and outside sleeves. They engage malleable iron fittings to which the bent loop eyes of the transverse and longitudinal diagonals are secured by through bolts. The diagonals are discontinuous at the center, where their ends have screw bearings on octagonal connection rings, a detail which certainly would not be adopted in this country. The column bases are seated on pairs of 12-inch transverse I-beams 29½ feet long, which are bolted together with separators to form sills. These are 9½ feet apart on centers and are connected by single 10-inch I-beams parallel to the bridge axis. The bents are capped with single 10-inch I-beams seated on the top castings and having 8-inch longitudinal beams web-connected to them. Pipes 2½ inches in diameter engage bosses on the connection castings and form horizontal struts at every story; they are braced laterally by 1-inch diagonal rods. This false work was especially designed for the erection of 100 and of 150-foot broad-gage spans each of which required four towers placed about 18 and 28 feet apart respectively. The sills and caps weigh from 800 to 1,100 pounds each, and the other pieces have a maximum weight of 260 pounds so that they can easily be transported in wagons or on mule back. The total weight of a tower 29 feet high is about 8 tons. They are erected by small gas pipe derricks clamped to the sections of the columns as the latter are assembled. Twenty natives and helpers will erect four towers 30 or 40 feet high in four days. Up to heights of 60 feet the towers have been found steady. A 100-foot tower was built double and guyed with wire ropes, but was reported somewhat unsteady. Each column of a 29-foot tower has an ultimate computed strength of about 42 tons, and each longitudinal top beam has a safe capacity for a uniformly distributed load of 31½ tons.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Regulations Concerning Foreign Commercial Agents.*—Portugal.—In Portugal foreign commercial agents are subject to a tax which varies, according to the nature of the business conducted, from 5 to 28 milreis ($5.40 to $30.24) per year. Samples entered which represent dutiable goods are registered by the customs authorities and supplied with proper identification labels. The duty must either be deposited or bond given for the amount, pending the re-exportation of the samples. All samples which were regularly registered on entry may be transported to any part of Portugal without being subject to any further tax or fee.

Roumania.—Traveling agents who sojourn in Roumania for less than three months, showing goods and taking orders, are exempt from all taxes. If this time is exceeded they are, in common with all foreigners, subject to the regular tax. They are required to report in writing their arrival in a city to the local chamber of commerce, and also present the powers of attorney authorizing them to do business for the given firm or firms. In case there is no chamber of commerce in a town, such report is to be made to the mayor. Agents must invariably be supplied with a trade license. In order that a power of attorney may be recognized it must have been visaed by the diplomatic representative of Roumania accredited to the country of which the agent is a citizen or in which the firm is located which issued to him the power of attorney to do business for its account. A copy of this power, properly certified, must accompany the written announcement to the local chamber or mayor. Upon receipt of these papers by the chamber, that body issues a certificate to the effect that the agent is qualified to do business in the locality.

Where samples are entered they must be accompanied by a written declaration giving an exact enumeration of all the goods carried. At the same time the agent must state a time limit within which he intends to re-export his samples. The duty on the same must be deposited or bond given for the amount. In case all samples are re-exported as indicated by their identity in the official registers, the duty is refunded or the bond canceled.

Russia.—Russia, the land of great possibilities for the merchant, imposes numerous taxes and fees upon the foreign commercial agent, or commercial house established within its borders, though the taxes have been considerably modified in character and reduced in amount during recent years.

A commercial house represented in Russia by an agent is subject to the following taxes:

(a) A State or real property tax of 150 rubles ($77.25). Before 1901 this tax was 500 rubles ($257.50) for all foreigners, but since that date the reduced tax has been in force for all merchants of foreign nationality with the exception of the Jews, who still pay the former tax of 500 rubles.

(b) A communal tax of 45 rubles ($23.17), which is paid but once.

Single traveling agents who have no permanently located house in the Russian Empire are subject to the following taxes as individual merchants:

(a) A State industrial tax of 50 rubles ($25.75).

(b) A communal tax of 10 rubles ($5.15).

In addition to this regular communal tax, there are a number of smaller taxes and fees to be paid to the local authorities. These are said to be insignificant, as a rule, and are expended for the benefit of the lower commercial schools. There is also a small tax, in the form of a supplementary tax of 10 per cent of the amount of the regular fee, exacted on the issuance of the trade license, the trade-license fee being a State tax, while the 10 per cent tax is a local communal tax.

Upon arrival in Russia, traveling agents are required to report at a custom house and obtain receipt upon payment of the prescribed fee. This receipt operates as a trade license and is good from the day of its issuance to the 1st of January following. It is attached to the national passport which every foreigner is compelled to produce on crossing the boundary of Russia, together with his power of attorney. These papers must be presented to the local industrial authorities of the place where business is to be done. In case of agents who travel in Russia only between July 1 and December 31 of each year the 50-ruble tax need be paid for the half-year only. Where a commercial house with permanent offices does business only during the second half of each year, the 150-ruble tax is reduced to 75 rubles ($38.63); but in case the proprietor of the house is of Jewish blood, he pays 250 rubles ($128.75), instead of the 500 rubles.

In case the head of a firm comes to Russia to do business without, however, establishing permanent offices, warehouses, etc., he is required to pay 150 rubles ($77.25); in case he is of Jewish origin, 500 rubles ($257.50). Where offices, depots, storerooms, etc., are established, a tax of 500 rubles ($257.50) is levied for the conducting of a wholesale trade, and 450 rubles ($231.75) for the conducting of a retail trade. When the head of the firm is a Jew he must, prior to entering into such business, receive permission from the Ministers of Finance, of the Interior, and of Foreign Affairs, in accordance with the circular issued November 27, 1900. In such a case, where the privilege is granted, the tax is 500 rubles ($257.50), whether the trade be wholesale or retail.

In the adjustment of the taxes for Jews the general rule prevails that the religion of the head of the firm determines the religion of the firm as a whole and of all agents and representatives sent out by such a firm. The proof of the religious denomination of a firm is attached to the trade license through the instrumentality of the compulsory visa. Certain special regulations are also in force covering Jewish traveling agents who desire to enter Russia for a period of three or six months.

When samples are carried by the traveling agent care must be taken to obtain a trade license, which for the sake of convenience is issued by the customs authorities of the port where entry is made, because it is only upon presentation of such license that the samples are admitted into the country without payment of the regular duty. Where the license is produced, the samples may be entered upon deposit of the amount of the duty, which is refunded upon the re-exportation of the samples as evidenced by the identifying labels which the Russian customs authorities attach to the same at the time of their entry.

The time limit within which the samples must be re-exported in order to obtain the refundment of the deposited duty was recently extended from six months to one year. Another reform which is a great convenience to agents carrying samples was instituted simultaneously with the preceding in that the re-exportation of samples may be made through ports of entry other than the one through which the samples were originally entered. The agent must, however, prepare two copies of a list of all his samples, and record weight, measurement, and other characteristics which might serve to identify them.

Firms that enter Russia with the intention only of making purchases of Russian goods are exempt from all taxation, and every possible freedom is accorded them for the transaction of their business.

Entry of samples need not necessarily be made at custom houses on the boundary; the samples may be shipped to some port of entry in the interior and the entry made there. However, it is said to be advisable to enter samples or other goods on the boundary wherever possible without loss or great inconvenience, because the fees and taxes are higher for entries made in the interior, including fees for trade licenses, etc. There is also said to be no regulation prohibiting the payment of the local taxes at some place where they are low (there is a difference in the amount to be paid in different localities).

For the entry of samples of combed wools Russia has prescribed special regulations. Such samples are admitted free of duty if they comply with the following requirements: They must be entered as samples and must not possess the appearance and character of salable goods; they must not exceed 4 "lot" in weight; they must be entered by some traveling agent or be addressed to some Russian wool manufacturing establishment.—J. F. Monaghan, Consul at Chemnitz, Germany.

* Based upon the Export-Handbuch, by Dr. August Etienne. For regulations for Austria-Hungary, France, Great Britain, Italy, Netherlands, and Norway, see Daily Consular Reports No. 1773 (October 13, 1903).

American Cider and Cider Vinegar in England.—Cider for English Consumption.—Owing to the unusual summer season, there was practically no apple crop in Great Britain, and as there has been in recent years a great increase in the consumption of cider in England many cider makers with established trade will be compelled this year to draw upon foreign cider makers or will have to import apples or apple rings in great quantities. Those purchasing foreign cider will wish to refine it here.

A cider maker tells me that ten or twelve years ago there was a good deal of American cider imported into this district, and the American methods of preparing it were then, he admits, superior to English methods. Some of this American cider had, he says, owing to the fact that it was shipped in barrels which had formerly held rye whiskey, a flavor which was very much liked. British cider makers, he claims, have to-day not only learned all the American methods for cider perfection, but have improved on these processes so much they believe they now prepare cider better than the Americans do, and that this is proven by the decrease in consumption here of the American cider and the increase in the consumption of English cider. At any rate, the English maintain that if they do not produce a better cider it is a cider better suited to English taste, for most of the American cider is of too light a quality. The English cider has greater body than the American, and English cider drinkers want a very heavy cider, just as English beer drinkers want a heavy beer. The great necessity, therefore, in shipping cider to this country will be to send a cider which has great body and which is so far free from foreign matter that fermentation will not be started while in transit.

I had a caller the other day—a cider maker—who wished to know whether it was at all likely that there was in the United States to-day any cider of good body a year old. He said he could use such cider, and I will place before him any cider proposition I receive as a result of this announcement.

Cider Vinegar.—To Americans visiting England it is a surprise to find that cider vinegar is not used here, malt vinegar being in general use, and it is malt vinegar, so it is claimed here, that preserves in such hard, firm shape the sour pickles made in England. I can not say that cider vinegar is not used in some sections of England, but usually if you mention cider vinegar to people they express surprise that anyone should use it, and even the cider maker who called on me the other day said his firm did not make cider vinegar for sale, but if they had a little cider that had fermented he used the vinegar at his own house. I wrote last year to a Birmingham gentleman, who owns a large farm at Herefordshire and always has delicious cider at his home made from his own apples, concerning cider vinegar, but he had never heard of such vinegar and referred me to a firm of cider makers in Herefordshire. When I wrote to this firm I asked why so little cider vinegar was used in England. The member of the firm who replied to me said that he "had used cider vinegar in his own house for many years, considering it superior for salads and fancy cookery to any of the malt products obtainable, but did not know why cider vinegar had not been made in England;" adding, "It is true, crab vinegar is found on farms, but this is, strictly speaking, malic acid, natural to the crab apple, and not a vinegar made by acidifying alcohol and cider." He also sent me a circular offering cider vinegar, which by a strange coincidence he had just issued and proposed to distribute among his customers "as a tentative measure to see how it would go."—Marshal Halstead, Consul at Birmingham, England.

Trade of Norway with the United States.—The trade of Norway with the United States is disappointing when the official records are consulted. Not only are these disappointing, but they give an inadequate idea of the real quantity of American goods consumed in Norway. In viewing the articles of trade offered for sale in the different shop windows, one is struck with the great number which are made in the United States. The same is true throughout Norway, American travelers inform me, but the trade reports fail to show any considerable quantity originating in the United States. The reason is simple; direct shipping facilities are poor and merchandise is accredited to the country of last port of shipment, much to the detriment of American trade reports. Salesmen from the United States with samples of goods could do much in building up American trade in Norway. Along the west coast, from September to May, there is a continual stream of German, English, French, and other European traveling salesmen, but it would be a novelty to see an American salesman in this country.

If European houses find Norwegian trade valuable enough to seek by personal representatives it would seem that American houses would find it quite as profitable, especially as so many Norwegians are disposed to favor American goods. There is scarcely a family on this coast but has some tie that binds it to the United States. A son, a daughter, a brother, or other near relative has gone to the United States to seek his or her fortune, and the many who return bring with them recollections of American trade that, given a fair chance, would yield handsome returns to American houses directly seeking the trade of Norway.

Corn, wheat, and rye, either in the grain or ground, are very largely imported.

Agricultural implements, cutlery, machinery, stationery, and many other articles should be bought and shipped direct instead of being purchased through English houses.—E. S. Cunningham, Consul at Bergen, Norway.

American Wood in Germany.—Kölnische Zeitung, a German commercial journal, says that imports of wood into Germany from the United States have more than trebled since 1880, amounting in 1902 to more than $5,850,000. It consisted mostly of pitch pine. This wood is more resistant to the weather and costs much less than oak, which averages $3.47 per 35.3 cubic feet, while pitch pine costs only $1.66 for the same amount. Owing to its utility and cheapness the pine is handled in the most remote parts of Germany. It is used for making doors, windows, floors, etc., while oak is used in the manufacture of the finer grades of furniture.

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Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

TRADE NOTES AND RECIPES.

Tombac Color on Brass.—This is produced by immersion in a mixture of copper carbonate 10 grammes, caustic soda 30 grammes, water 200 grammes; this layer, however, will only endure wiping with a cloth, not vigorous scouring with sand. To give brass a brown color, it is first coated with a dilute solution of mercurous oxide, and then with a solution of sulphantimoniate of sodium (Schlippe's salt).

Nickeling Fluid for All Metals.—Dissolve in 20 liters of water 1 kilogramme of nickel sulphate, 725 grammes of neutral ammonium tartrate, 5 grammes of tannic acid dissolved in ether in such a manner as to first place the substances in 3 to 5 liters of very hot water, then filtering the solutions and diluting with the remaining water. The bath must be perfectly neutral. This liquid is suitable for nickeling any metal.—Mechaniker.

Preserving Leather.—The following formulas are taken from "Workshop Receipts":

(1) Equal parts of mutton fat and linseed oil, mixed with one-tenth their weight of Venice turpentine, and melted together in an earthen pipkin, will produce a "dubbin" which is very efficacious in preserving leather when exposed to wet or snow, etc. The mixture should be applied when the leather is quite dry and warm.

(2) A solution of 1 ounce of solid paraffin in 1 pint light naphtha, to which 6 drops of sweet oil have been added, is put cold on the soles, until they will absorb no more. One dressing will do for the uppers. This process is claimed to vastly increase the tensile strength.

Production of Blue Bronze.—Blue bronze is produced by the wet process by coloring white bronze (silver composition) by means of aniline blue. After it had been attempted for a long time, though in vain, to obtain handsome blue annealing colors of durability by heating, it was found that a blue bronze color could be produced in the ordinary way, from white bronze color, the product of pure English tin, and with an alum solution consisting of 20 grammes of alum in 4½ liters of water boiled for five hours and washed out clean and dried. The bronze prepared in this manner is placed in a porcelain dish, mixed with a solution of 15 grammes of aniline blue in 1½ liters of alcohol, stirring the bronze powder and liquid until the alcohol has evaporated entirely and the bronze color becomes dry. This manipulation has to be repeated six or eight times, until the desired blue shade is reached. When the bronze is dark enough it is washed out in warm water, and before entirely dry, one tablespoonful of petroleum is poured on 1 kilo of bronze, which is intimately mixed and spread out into a thin layer, exposed to the air, whereby the smell is caused to disappear in a few days.

Bronzing and Patinizing of Small Zinc Articles.—The patinizing of zinc articles has become a very important question in the art industry, as many articles formerly only made of bronze and consequently very expensive, are now manufactured of zinc and present no less handsome an appearance, besides being far cheaper. The so-called "bronze" clock cases of the Paris manufacturers, candlesticks, writing sets, statuettes, and other art objects are frequently nothing but skillfully patinized or bronzed zinc castings, the price being accordingly lower than that of genuine bronze. Coatings of bronze tones and patina shades may be produced on zinc by means of various liquids, but the articles, before being worked upon, should be rubbed down with very fine glass or emery paper, to make them not only perfectly metallic but also somewhat rough, as a consequence of which the bronze or patina coatings will adhere much better. The nicest bronze or patina effects on bronze are obtained by electroplating the article with not too thin a deposit of brass rich in copper and then treating them like genuine bronze. The solutions used, however, must always be highly diluted, otherwise it may happen that they will eat entirely through the thin metallic coating.—Der Metallarbeiter.

Gilding of Brass Goods.—On brass, which is an electropositive metal, an electromagnetic metal such as gold can be deposited very cheaply from the dilute solutions of its salts. The deposit is naturally very thin, but still quite adhesive. In preparing the same, the proportions stated below have to be accurately observed, otherwise no uniform, coherent coating will result, but one that is uneven and spotted.

In ¾ liter of water dissolve: Phosphate of soda 5 grammes and caustic potash 3 grammes, and in ¼ liter of water, gold chloride 1 gramme and potassium cyanide 16 grammes. Mix both solutions well and cause the mixture to boil, whereupon the brass articles to be gilded are immersed. The gold in the mixture can be utilized almost entirely. When the solution does not gild well any more a little potassium cyanide is added, and it is used for pre-gilding the articles which can then be gilded again in a fresh solution. As mentioned, this solution is very weak. A stronger one can be prepared mechanically by dissolving 2 to 3 grammes of gold chloride in very little water to which 1 gramme of saltpeter is added. Into this solution dip linen rags, let them dry in a dark place, and cause them to char into tinder, which is rubbed up in a porcelain dish. Dip a soft, slightly charred cork moistened with a little vinegar into this powder, or else use only the finger, and rub the gold powder upon the brass articles.—Werkmeister Zeitung.

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